# PROTOCOLS FOR THE ESTABLISHMENT OF EXCEPTIONAL RESOURCE VALUE WETLANDS PURSUANT TO THE FRESHWATER WETLANDS PROTECTION ACT (N.J.S.A. 13:9B-1 ET SEQ.) BASED ON DOCUMENTATION OF STATE OR FEDERAL ENDANGERED OR THREATENED SPECIES

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A cooperative effort of
THE LAND USE REGULATION PROGRAM

OFFICE OF NATURAL LANDS MANAGEMENT
DIVISION OF PARKS AND FORESTRY
and
THE ENDANGERED AND NONGAME SPECIES PROGRAM
DIVISION OF FISH AND WILDLIFE

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## INTRODUCTION

As part of its legal mandate to implement the provisions of the Freshwater Wetlands Protection Act (Act)(N.J.S.A. 13:9B-1 et seq.), the Department of Environmental Protection (Department) has developed the following protocols for designating freshwater wetlands of exceptional resource value based on documentation of endangered or threatened species. In developing these protocols, Department staff has conducted an extensive review of the scientific literature and field studies available for each species. Criteria believed to define the presence, absence, and distribution of each species in a particular habitat type (e.g. home range, movement patterns, habitat use characteristics, predator and prey relationships, population ecology) were integrated to establish, where possible, a practical and predictable framework through which the requirements of the Act can be met.

The guidelines provided below are not intended to be inflexible in nature. Rather, they should be considered as a outline within which blocks of wetland habitat will be evaluated on a case by case basis for an exceptional resource value classification under the Act. In addition, the Department views the wetland classification process as evolutionary, with protocols for each species being added, deleted, or modified, as experience and new scientific information warrant. To facilitate this process, each individual species protocol will be dated so that new versions may be distinguished from older ones. We believe that these protocols will provide the regulated public with a better understanding of the science and rationale that go into implementing the resource value and transition area requirements of the Act. While the target audience for the protocols is the environmental consultant community, the information provided may assist all parties of the public and private sector in understanding endangered or threatened species and their habitats and how they may affect the regulatory process.

## LEGAL BASIS

The Freshwater Wetlands Protection Act, at N.J.S.A. 13:9B-7, directs the Department to develop a system for the classification of freshwater wetlands based upon criteria which distinguish between wetlands of exceptional resource value, intermediate resource value, and ordinary resource value. Wetlands of exceptional resource value are described as those which discharge into FW-1 or FW-2 trout production waters and their tributaries, or those which are present or documented habitats for endangered or threatened species which remain suitable for breeding, resting, or feeding, by these species during the normal period these species would use the habitat. Further clarification of "documented habitats" is provided in the FWPA Rules at N.J.A.C. 7:7A-1 which define such habitats as "areas for which:

1. There is recorded evidence of past use by a threatened or endangered species of flora or fauna for breeding, resting or feeding. Evidence of past use by a species may include, but is not limited to, sightings of the species, or of its sign (for example, skin, scat, shell, track, nest, herbarium records etc.), as well as identification of its call; and

2. The Department makes the finding that the area remains suitable for use by the specific documented threatened or endangered species during the normal period(s) the species would use the habitat."

Wetlands designated as being of exceptional resource value receive additional levels of protection under the guidelines for establishing transition areas (13:9B-16) and obtaining transition area waivers (13:9B-18) and the issuance of wetland permits (13:9B-9) and statewide general permits (13:9B-23).

RATIONAL

This document represents the third edition of the Department's guidance on how freshwater wetlands will be classified based on documentation of endangered or threatened species and is broken down into three sections. The first will discuss how the Department will interpret individual sightings of endangered or threatened animal species and translate them into "areas of documentation' using the Endangered and Nongame Species Program's (ENSP) Landscape Maps for the purposes of implementing the requirements of the FWPA. The second section will consist of individual endangered or threatened animal species habitat discussions. The third will discuss the protection applied to federally listed plant species under the FWPA.

In the first edition of the FWPA Protocols (DEP 1995), the Department largely focused on protecting only those habitats known to be occupied and suitable for use by an individual or local population of a particular species. Suitable habitat outside of the estimated area of use by these animals was not considered to be a "documented habitat" and therefore not considered to be endangered or threatened species habitat whether or not that habitat was contiguous with the "documented" habitat. At that time, the Department felt that this strategy was the best applied approach to (1) ensure appropriate natural resource protection, and (2) provide for consistency and predictability in the regulatory process.

However, changes to New Jersey's landscape over the last 10-15 years and the evolution of landscape based habitat protection theories have led the Department to re-evaluate this protection strategy. The rapid suburbanization of our landscape has led to the loss and degradation of critically important wildlife habitats, and the fragmentation and isolation of the habitats that remain. Many rare species populations require large contiguous blocks of habitat to survive. Small patches of fields, forests and wetlands interspersed with development provide habitat for some common species, but don't provide the necessary habitat for the long-term protection of most of our endangered or threatened animal species. Examples of these conditions include the loss of 40 percent of the remaining critical migratory bird stopover habitat on the lower third of the Cape May Peninsula and approximately 50 percent of the state's bog turtle habitat during the last three decades. In addition, recent studies conducted to assess the status of the state-listed raptors in south Jersey have raised questions about the long-term stability of their populations (Sutton and Dowdell 2001). As a result, the Department conducted a re-assessment of its regulatory

efforts under the FWPA to see if the above objectives were being met and determined that a change in approach was necessary.

To this end, the Department sought to establish a more population driven parameter of habitat protection which would best ensure the continued, long-term existence of a particular documented species or population in an identified wetland habitat. As a solution, the Department decided in July 2002 to replace the past, species, sighting-specific "areas of documentation" with the species population/ habitat complex Landscape Maps to improve upon both the predictability and quality of the habitat protection provided under the FWPA. This version of the Department's protocols incorporates changes made to the Landscape methodolgy which attenpt to futher identify those specific habitats in need of protection for each species. In addition, some of the species specific habitat discussions have been up-dated to incorporate the results of more recent scientific work. A summary of the new species protocols developed to date is provided in Tables 1-5. Each species protocol occurring in the second section of this document provides a discussion on the following topics:

a. The species' distribution in New Jersey;

b. A summary of the habitat types and characteristics used by the species for feeding, resting and breeding;

c. A summary of survey methodologies used to identify the presence or absence of the species; and

d. A Fish and Game contact person for additional information on the species and their habitats;

e. Primary authors and date of protocol draft; and

f. A literature cited section.

For additional information on the development of these protocols, please contact Larry Torok of the Land Use Regulation Program at (609) 633-6755 or Mike Valent of the Endangered and Nongame Species Program at (908) 735-8975

CAUTIONS

The Department notes that the Landscape Project maps represent an approximation of the location and extent of "documented" endangered or threatened species habitat. Because these maps are based upon NJDEP's air photo-based land-use/land-cover data, they do not replace the case by case assessment of the wetlands on any particular property. The Department will also use other sources of information relating to the presence or absence of endangered or threatened species including, but not limited to, new, valid sightings received from the applicant or members of the interested public

which have not yet been incorporated into the Landscape mapping, or the results of Department conducted or sponsored status surveys of listed species.

In addition, because the wetland classification process is evolutionary, it must be re-emphasized that the protocols provided are subject to change, deletion, or addition as new information or experience dictate. The absence of a protocol for a particular endangered or threatened species does not prevent wetland habitats being used by such species from being designated as exceptional resource value on a case by case basis. Such listed species as Cooper's hawks (*Accipter cooperii*), yellow-crowned night-herons (*Nyctanassa violaceus*) or peregrine falcons (*Falco peregrinus*) may rely upon freshwater wetland habitats for their continued existence in certain circumstances. To obtain a legal determination of a wetland classification and subsequent regulatory restrictions, it is recommended that a formal Letter of Interpretation be obtained from the Department. In addition, the protection standards provided below are largely designed for regulatory purposes and may not be entirely ideal for wildlife habitat conservation purposes. The Department cautions against applying these standards universally in instances where long-term landuse and conservation goals are desired.

**Literature Cited**

Department of Environmental Protection. 1995. Protocols for the establishment of exceptional resource value wetlands pursuant to the Freshwater Wetlands Protection Act ( N.J.S.A. 13:9B-1 et seq.) based on documentation of state of federal endangered or threatened species. NJDEP, Landuse Regulation Program, Office of Natural Lands Management, and Endangered and Nongame Species Program. Trenton, New Jersey. pp. 152.

Sutton, C. and J. Dowdell. 2001. Woodland raptor surveys in the Bellplain State Forest Region and elsewhere in Cape May, Cumberland, and Atlantic Counties, New Jersey. Spring 2001. pp. 7 plus appendices.

## TABLE ONE: STATE ENDANGERED HERPTILE PROTOCOLS

| **Species** | **Listed Status** | **Area of Documentation** | **Suitable Wetland Habitats** |
|---|---|---|---|
| Blue-spotted salamander | NJ(E) | Forest<br>Forested Wetland<br>Emergent | 1-3m deep pond surrounded by forest with a dense litter base. |
| Tiger salamander | NJ(E) | Forest<br>Forested Wetland<br>Emergent | 1-3m deep pond with >1 side forested with additional forested corridors. Few or no predators. |
| Bog Turtle | NJ(E)<br>US(T) | Forested Wetland<br>Emergent | Emergent or scrub-shrub wetlands within wetland complex association with sighting. |
| Timber Rattlesnake | NJ(E) | Forest<br>Forested Wetland | North-All mapped wetland habitats for foraging. South-Forested riparian habitat. Forested wetland w/dense surface vegetation and litter. Favors sandy soils, upland foraging habitat. Occasional upland denning sites. |
| Pine Barrens treefrog | NJ(T) | Forest<br>Forested Wetland<br>Emergent | Typical habitat: ponds 0.1 <> 2 m. deep or with 75% of area 0.1<>2 m. deep. Aver shrub ht. 1.6 m, pH 3.8<>4.6, open canopies. |
| Southern gray treefrog | NJ(E) | Forest<br>Forested Wetland<br>Emergent | Mixed forest ponds, open bog areas, gravel pits, floodplain wetlands. Forested adj. Uplands important. |

## TABLE TWO: STATE THREATENED HERPTILE PROTOCOLS

| **Species** | **Listed Status** | **Area of Documentation** | **Suitable Wetland Habitats** |
|---|---|---|---|
| Wood turtle | NJ(T) | **Please refer to *DETAILED METHODOLOGY FOR DELINEATING CRITICAL AREAS BY SPECIAL HABITAT REQUIREMENTS* section on page 20.** | Mosaics of forested, scrub-shrub, emergent wetlands, upland forest, old fields and agricultural lands. |
| Long-tailed Salamander | NJ(T) | Forested Wetland<br><br>Emergent<br>Forest | Hardwood forest overstory. Ponds associated with limestone outcrops. Shallow streams with shale bottoms. |
| Mud Salamander | NJ(T) | No Records in current Landscape Mapping | Wetlands associated with locale of sighting. |

## TABLE THREE: STATE ENDANGERED BIRD SPECIES PROTOCOLS

| **Species** | **Listed Status** | **Area of Documentation** | **Suitable Wetland Habitats** |
|---|---|---|---|
| Henslow's sparrow | NJ(E) | Grassland<br>Emergent | Seasonally saturated emergent wetlands, sparse shrub cover, 1-2m high. |
| Short – eared owl | NJ(E) | No Records in current Landscape Mapping<br>Grassland<br>Emergent | Seasonally saturated emergent scrub/shrub habitats |
| Red – shouldered hawk | NJ(E) | Forest<br>Forested Wetland | Hardwood, softwood, or mixed swamp featuring mature, closed overstory, variable to dense understory, near streams or open water. |
| Northern harrier | NJ(E) | Emergent<br>Grassland | Open field, meadow, emergent marsh, or wet agricultural areas. |
| Sedge wren | NJ(E) | Emergent<br>Grassland | Seasonally saturated marsh, meadows, or wet fields. Sedges, rushes, and grass dominate. Sparse 1-2m. shrub layer. |
| Bald eagle (breeding) | NJ(E)<br>US(T) | Forest<br>Forested Wetland<br>Emergent<br>Grassland | All wetlands contiguous with a 1 km radius of a nest site will be assessed as they relate to maintaining a suitable nest environment. |
| Bald eagle foraging. | | Please refer to *DETAILED METHODOLOGY FOR DELINEATING CRITICAL AREAS BY SPECIAL HABITAT REQUIREMENTS* in section one of the protocols. | Forested wetlands and uplands featuring dead/live 12 cm. Dbh. PSS/PEM considered on a case by case basis. |
| Pied – billed grebe | NJ(E) | Emergent | Mosaics of open water and emergent vegetation (e.g. cattails, bullrushes, phragmites. |

## TABLE FOUR: STATE THREATENED BIRD PROTOCOLS

| **Species** | **Listed Status** | **Area of Documentation** | **Suitable Wetland Habitats** |
|---|---|---|---|
| Long – eared owl | NJ(T) | Grassland<br>Forest | Linear forest hedgerow or stands of moderate age. Emergent or scrub-shrub wetland field habitats. |
| American bittern | NJ(T) | Emergent | Emergent marsh habitats featuring cattails and sedges. |
| Bobolink | NJ(T) | Grassland | Open field or meadow. Dominated by grasses or forb species. Sparse saplings and fence posts used for perches. |
| Black rail | NJ(T) | Emergent | Freshwater or brackish, fringe marshes featuring emergent vegetation (e.g. grasses, sedges, rushes). |
| Red – headed woodpecker | NJ(T) | Forest | Floodplain, or flooded wetlands typified by dead trees, open understories, and mast. |
| Osprey | NJ(T) | Emergent<br>Beach | Forested, scrub-shrub, or emergent wetlands w/in proximity to nest structure. |
| Barred owl | NJ(T) | Forest<br>Forested Wetland | Hard, soft, or mixed forest stands featuring closed canopies and open to variable understories. |

## TABLE FIVE: STATE ENDANGERED MAMMAL PROTOCOLS

| **Species** | **Listed Status** | **Area of Documentation** | **Suitable Wetland Habitats** |
|---|---|---|---|
| Indiana Bat | NJ(E)<br>US(E) | Forest<br>Forested Wetland | Forested hardwood wetland complexes, often in associated with floodplains, streams and waterbodies. |

## TABLE SIX: FEDERALLY LISTED PLANT PROTOCOLS

| **Species** | **Listed Status** | **Area of Documentation** | **Suitable Wetland Habitats** |
|---|---|---|---|
| **Endangered** | | | |
| *Isotria medeoloides* Small-whorled pogonia | US(E)<br>NJ(E) | Case by case basis | Braided stream, secondary growth hard or softwood forests with Loam soils. |
| **Threatened** | | | |
| *Aeschynomene virginica* sensitive joint vetch | US(T)<br>NJ(E) | Case by case basis | Across a gradient of freshwater to brackish emergent tidal river marshes. |
| *Helonias bullata* swamp pink | US(T)<br>NJ(E) | Case by case basis | Mucky soils, dense canopy or understory, sphagnum hummock bogs. Habitats infrequently flooded. |
| *Ryhnchospora knieskernii* Knickern's beaked rush | US(T)<br>NJ(E) | Case by case basis | Early successional or disturbed communites with dense soils and vegetative communities of grasses and other rushes. |

# SECTION I.

## LANDSCAPE PROJECT MAPPING - PROTOCOL FOR IDENTIFYING AND DELINEATING CRITICAL WILDLIFE HABITAT

## INTRODUCTION

The following section is an adaptation of the discussions and guidance provided in the Department's New Jersey's Landscape Project publication (Niles et al. 2004). For the purposes of implementing the resource value classification sections of the Freshwater Wetlands Protection Act, freshwater wetlands delineated within habitat patches identified as "critical areas" will be considered to fall within "areas of documentation" for regulatory purposes.

For complete details on Landscape Project Mapping consult the Department's website at: *http://www.nj.gov/dep/fgw/ensp/landscape/index.htm*

## LAND USE/LAND COVER

The land-use/land-cover data that formed the basis of Version 1.0 of the Landscape Project was a raster-based classification developed by Rutgers University Center for Remote Sensing and Spatial Analysis (CRSSA). This dataset was based on Landsat Thematic Mapper imagery that was enhanced with other ancillary data such as US Fish and Wildlife Service wetland maps, New Jersey Department of Environmental Protection (NJDEP) freshwater wetland maps and Natural Resource Conservation Service county soil maps. ENSP selected CRSSA's raster-based dataset (CRSSA LC) over the NJDEP's vector-based land-use/land-cover dataset (LU/LC) primarily because it could be easily updated to reflect the rapidly changing habitat conditions within New Jersey. Changes in land use and land cover have a profound influence on wildlife habitat and ENSP biologists wanted the ability to update the Landscape maps on a frequent basis.

In Version 2.0, the ENSP opted to use the NJDEP's air photo-based land-use/land-cover data primarily because of the desire for consistency with other geographic data and mapping applications that employ these data across the Department. The increased resolution of the aerial photo-based data and the commitment by the Department to update the 1995 data with 2002 imagery provided additional rationale for using the NJDEP LU/LC data.

NJDEP's Division of Science, Research and Technology conducted a study with ENSP, other NJDEP programs (Bureau of Geographic Information Systems; Office of Natural Lands Management; and the Forest Service) and Rutgers CRSSA in which detailed analyses of five geographic data sets that characterize New Jersey's diverse landscape were compared (Lathrop and Hasse 2003). This research revealed several important differences between the NJDEP LU/LC and the CRSSA LC datasets.

Vector-based polygon data is represented by individual points and the line segments that connect them. As a result, line segments can form irregular shapes of varying areas to accurately depict land features in detail. Raster layers are based on a regularly spaced grid with rectangular shaped cells. Since a cell can have only one value, classification involves calculating the land class that makes up the majority of the cell and assigning it that value. Since the cells cannot be divided the result is a jagged, less accurate border around each land-use type. Therefore, the vector-based data has the benefit of topological capabilities as well as database functionality that is better suited for regulation, planning and management applications.

In addition, the NJDEP LU/LC was created from visual photo-interpretation and therefore is able to use shape, pattern and context to accurately map land features in detail. The CRSSA LC uses spectral reflectance values to differentiate land covers. Many factors can influence the accuracy of this technique such as climatic conditions, seasonal variation and heterogeneity of spectral signatures for particular land covers.

The NJDEP LU/LC classifies land use and land cover by assigning one of 66 classes described in Anderson et al. (1976). CRSSA LC uses a classification that is based on the physical material covering the earth's surface. Consequently, some areas are classified differently by the two methods. For example, lawn areas in parks are classified by the NJDEP LU/LC as developed. CRSSA LC classifies the same area as grasslands. Due to these differences some of the LU/LC classes had to be modified to include known wildlife habitat.

Wetlands are also treated differently by the two systems and may result in different classifications for similar land types. For example, the NJDEP LU/LC classifies wet hayfields as wetlands due to their regulatory status, but CRSSA LC may classify the same area as grasslands. Mapping resolution and precision of the NJDEP LU/LC maps is slightly improved in comparison to the CRSSA-derived maps, and the ENSP based its decision to use the NJDEP LU/LC on these factors. However, because some of the species models (eg. bald eagle foraging and colonial waterbird foraging) were developed for Version 1.0 they are calculated using raster-based data and then converted to a vector-based polygon for inclusion in the Landscape Project.

For complete details on New Jersey 1995/97 Land Use/Land Cover Update Project consult the Department's website at: *http://www.nj.gov/dep/gis/supfiles.html*

**SPECIES DATA**

Documented occurrences of imperiled species are used to determine critical areas. The majority of the species data used in the Landscape Project are taken directly from the Natural Heritage Program's (NHP) Biological Conservation Database (BCD) GIS coverage. Wildlife records in the BCD are derived from a variety of sources. These include ENSP surveys, NJDEP staff reports, private consultant reports and reports from the general public. ENSP staff is responsible for verifying all submitted records prior to acceptance. All verified sightings are mapped on 1:24000 USGS 7.5' topographic maps or the most recent color infrared aerial imagery by a staff biologist prior to entry into the BCD. Only seconds precision records (mapped to within one second of latitude and longitude) with a last observation date of 1970 or later are used to delineate and classify critical areas.
Models are applied to all species data that are used to generate the Landscape Project critical area maps. Some models were developed based on home range/territory sizes reported in the scientific literature. Other species models consist of polygons having an area equivalent to one second of latitude and longitude with the actual sighting location at the center, or a digitized polygon that represents the habitat used by the species as defined in the NHP's Element Occurrence Specification Standards.

## GENERAL METHODOLOGY FOR DELINEATING CRITICAL AREAS

The method for delineating critical areas is relatively straightforward. First, the relevant classes for each habitat type (forest, grassland, forested wetland, emergent wetland and beach) are extracted from the NJDEP's LU/LC data layer. Dissolving the different LU/LC classes for each habitat type creates contiguous habitat polygons. Using boundaries between habitat types and major roads (county level 500 and above), contiguous patches for each habitat type are delineated. Each patch is then assigned a unique link ID. Imperiled species models are then intersected with habitat patches. Habitat patches are classified based on the status of the species present as follows:

- **Rank 5** is assigned to patches containing one or more occurrences of at least one wildlife species listed as endangered or threatened on the Federal list of endangered and threatened species.
- **Rank 4** is assigned to patches with one or more occurrences of at least one State endangered species.
- **Rank 3** is assigned to patches containing one or more occurrences of at least one State threatened species.
- **Rank 2** is assigned to patches containing one or more occurrences of at least one non-listed State priority species.
- **Rank 1** is assigned to patches that meet habitat-specific suitability requirements such as minimum size criteria for endangered, threatened or priority wildlife species, but that do not intersect with any confirmed occurrences of such species.

## DETAILED METHODOLOGY FOR DELINEATING CRITICAL AREAS BY HABITAT TYPE

### FOREST:

Critical area maps for forest-dependent species are generated by selecting specific land-use classes from the NJDEP's LU/LC data set. Using GIS software, the ENSP has developed the following protocols:

#### Outside of the Pinelands

- Extract all appropriate forest types (upland and wetland forests) from the NJDEP LU/LC dataset into one forest layer.
- Combine all of the NJDEP LU/LC forest types that are directly adjacent to one another by dissolving the boundaries between them making a layer of contiguous forest polygons.
- Bisect the resulting forest coverage using major roads (500 level and above) to create ecologically significant boundaries between contiguous forest patches.
- Clip the resulting forest coverage by the Pinelands Area Boundary of New Jersey.
- Identify these patches and sections of patches as Pineland Area patches.

**For Pinelands Area patches proceed to protocol under the subheading "Pinelands." For forest patches outside of the Pinelands Area continue below:**

- Identify forest patches that have a core area of 10 hectares or greater. Core area is defined as interior forest greater than 90 meters from the forest edge.
- Buffer all forest patches inward from the perimeter by 90 meters.
- Erase this buffer from each patch.
- If the sum of the remaining area is 10 hectares or greater, then the original patch is re-coded as core. These patches receive a minimum rank of 1.
- Combine the Pinelands Area patches and sections of patches with the remaining forest patches that are directly adjacent to one another by dissolving the boundaries between them making a layer of contiguous forest polygons.
- Assign each new patch a unique Link ID used for tracking patches.
- Intersect forest species models with the new forest layer. This intersection results in a new layer with the Link ID from the forest layer and an ID from the species models. From this layer queries can be made to determine the number of records and conservation status of each patch based on the species present.
- All forest patches in the Coastal Landscape Region and the lower 10 kilometers of the Cape May peninsula are considered critical areas due to the importance of these habitats to migrating birds. These patches receive a minimum rank of 1 regardless of whether or not they contain 10 hectares of core forest.
- Habitat patches are classified based on the conservation status of the species present as detailed in the "General Methodology for Delineating Critical Areas," section.

**Pinelands**

- Identify Pinelands Area connection corridors. Pinelands Area patches connected by any corridor that is greater than 91.44 meters in length and less than 91.44 meters wide are considered separate patches.
- Buffer all forest patches inward from the perimeter by 45.73 meters. This action eliminates all Pinelands connecting corridors that do not meet the required dimensions.
- Pinelands Area patches that meet the required dimensions are buffered outward from the perimeter by 45.73 meters and merged with any overlapping forest polygons. This buffer brings the forest patch back out to its original extent minus Pinelands connection corridors that do not meet the required dimensions.
- Identify Pineland Area patches that have a core area of 10 hectares or greater. Pinelands core area is defined as contiguous interior forest greater than 90 meters from the forest edge.
- Buffer all forest patches inward from the perimeter by 90 meters.
- Erase this buffer from each patch.
- If a contiguous section of the remaining area is 10 hectares or greater, then the original patch is re-coded as core and receives a minimum rank of 1.
- Combine the Pinelands Area patches and sections of patches with the remaining forest patches that are directly adjacent to one another by dissolving the boundaries between them making a layer of contiguous forest polygons.
- Assign each new patch a unique Link ID used for tracking patches.
- Intersect forest species models with the new forest layer. This intersection results in a new layer with the Link ID from the forest layer and an ID from the species models.

From this layer queries can be made to determine the number of records and conservation status of each patch based on the species present.

- All forest patches in the Coastal Landscape Region and the lower 10 kilometers of the Cape May peninsula are considered critical areas due to the importance of these habitats to migrating birds. These patches receive a minimum rank of 1 regardless of whether or not they contain 10 hectares of core forest.
- Habitat patches are classified based on the conservation status of the species present as detailed in the "General Methodology for Delineating Critical Areas," section.

**FORESTED WETLAND**

Critical area maps for forested wetland dependent species are generated by selecting specific land-use classes from the NJDEP's LU/LC data set. Using GIS software, the ENSP has developed the following protocol:

- Extract all appropriate forested wetland types from the NJDEP's LU/LC data set into one forested wetland layer.
- Combine all of the NJDEP LU/LC forested wetland types that are directly adjacent to one another by disolving the boundaries between them making a layer of contiguous forested wetland polygons.
- Bisect the resulting forested wetland coverage with major roads (500 level and above) to create ecologically significant boundaries between contiguous forested wetland patches.
- Assign each new patch a unique Link ID used for tracking patches.
- All forested wetland patches are considered critical areas regardless of size. Therefore, all forested wetland patches receive a minimum rank of 1.
- Intersect forested wetland species models with the new forested wetland layer. This intersection results in a new layer with the Link ID from the forested wetland layer and an ID from the species models. From this layer queries can be made to determine the number of records and conservation status of each patch based on the species present.
- Habitat patches are classified based on the conservation status of the species present as detailed in the "General Methodology for Delineating Critical Areas," section.

**EMERGENT WETLAND**

Critical area maps for emergent wetland dependent species are generated by selecting specific land-use classes from the NJDEP's LU/LC data set. Using GIS software, the ENSP has developed the following protocol:

- Extract all appropriate emergent wetland types from the NJDEP's LU/LC land-use/land-cover data set into one emergent wetland layer .
- Combine all of the NJDEP LU/LC emergent wetland types that are directly adjacent to one another by disolving the boundaries between them making a layer of contiguous emergent wetland polygons.
- Bisect the resulting emergent wetland coverage with major roads (500 level and above) to create ecologically significant boundaries between contiguous emergent wetland patches.
- Assign each new patch a unique Link ID used for tracking patches.
- All emergent wetland patches are considered critical areas regardless of size. Therefore, all emergent wetland patches receive a minimum rank of 1.

- Intersect emergent species models with the new emergent wetland layer. This intersection results in a new layer with the Link ID from the emergent wetland layer and an ID from the species models. From this layer queries can be made to determine the number of records and conservation status of each patch based on the species present.
- Habitat patches are classified based on the conservation status of the species present as detailed in the "General Methodology for Delineating Critical Areas," section.

**GRASSLAND:**

Critical area maps for grassland dependent species are generated by selecting specific land-use classes from the NJDEP's LU/LC data set. Using GIS software, the ENSP has developed the following protocol :

- Extract all appropriate grassland habitat types from the NJDEP's LU/LC data set into one grassland layer.
- Combine all of the NJDEP LU/LC grassland types that are directly adjacent to one another by disolving the boundaries between them making a layer of contiguous grassland polygons.
- Bisect the resulting grassland coverage with major roads (500 level and above) to create ecologically significant boundaries between contiguous grassland patches.
- Assign each new patch a unique Link ID used for tracking patches.
- Select all grassland patches greater than 18 hectares. These patches meet the minimun size requirement for grasslands and receive a minimum rank of 1.
- All grassland patches in the lower 10 kilometers of the Cape May peninsula are considered critical areas. This is due to the importance of this habitat to migrating birds. These patches receive a minimum rank of 1 regardless of whether or not they contain 18 hectares of core.
- Intersect grassland species models with the new grassland layer. This intersection results in a new layer with the Link ID from the grassland layer and an ID from the species models. From this layer queries can be made to determine the number of records and conservation status of each patch based on the species present.
- Habitat patches are classified based on the conservation status of the species present as detailed in the "General Methodology for Delineating Critical Areas," section.

**BEACH**

Critical area maps for beach dependent species are generated by selecting specific land-use classes from the NJDEP's LU/LC data set. Using GIS software, the ENSP has developed the following protocol :

- Extract the beach habitat type from the NJDEP's LU/LC data set. Only one beach class exists in the data set.
- Beach habitats are bisected by natural breaks such as inlets and rivers and by hand digitized boundaries around species locations.
- Assign each new patch a unique Link ID used for tracking patches.
- All beach patches are considered critical areas regardless of size. Therefore, all beach patches receive a minimum rank of 1.
- Intersect beach species models with the new beach layer. This intersection results in a new layer with the Link ID from the beach layer and an ID from the species models.

From this layer queries can be made to determine the number of records and conservation status of each patch based on the species present.

- Habitat patches are classified based on the conservation status of the species present as detailed in the "General Methodology for Delineating Critical Areas," section.

## DETAILED METHODOLOGY FOR DELINEATING CRITICAL AREAS BY SPECIAL HABITAT REQUIREMENTS

For some species, additional specific mapping protocols were developed and are set forth below.

## BALD EAGLE FORAGING AREA

All known bald eagle nests are recorded using GPS equipment. To run the model, all water polygons from the NJDEP LU/LC having an area greater than 8 hectares are converted to a 5-meter grid. A radius around the nest site is incrementally increased, one cell (5 meters) at a time, until an area of 660 hectares of open water has been identified. All emergent wetland patches within 90 meters of the identified water are selected. The emergent wetland patches are merged with the identified open water. A 90-meter buffer is applied to the combined water/emergent wetland layer to protect perching sites. In the previous version (1.0) all habitat patches that intersected with the foraging habitat and 90-meter buffer were designated as critical areas. In Version 2.0 bald eagle foraging habitat, and its associated 90-meter buffer, is no longer used to value patches that intersect with it. The bald eagle foraging model is a stand-alone GIS layer that is not used to value habitat patches.

## PEREGRINE FALCON

In Version 1.0 of the Landscape Project, emergent wetland patches that intersected a 1-kilometer radius area delineated around a peregrine falcon nest were valued as peregrine falcon habitat.

In Version 2.0, peregrine falcon nests are separated into two types, urban and non-urban depending on the type of landscape in which they are located. For urban nests a 1-kilometer radius area around the nest is now valued as peregrine falcon habitat regardless of the land-cover type. Urban peregrine nests continue to value emergent wetland patches that intersect with the 1-kilometer radius area delineated around a peregrine falcon nest. Non-urban peregrine falcon nests continue to value only emergent wetland patches that intersect with the 1-kilometer radius area around the nest. The urban peregrine falcon model is a stand-alone GIS layer that values emergent wetland habitat patches.

## WOOD TURTLE

Critical areas for wood turtles are mapped following a four-step process.
A 1.6-kilometer radius is placed around each wood turtle sighting location in the BCD. A 322-meter buffer is then applied to all streams that fall within the 1.6-kilometer radius. The NJDEP LU/LC is then overlaid on the buffered areas and all areas classified as urban, with the exception of powerline rights-of-way, are deleted from the buffer. NJDEP Freshwater Wetland Maps are overlaid on the stream buffers, and all wetlands that intersect the buffer are clipped within the

1.6-kilometer radius and are merged into the stream/buffer polygon. The final step of the process involves a detailed quality control check and revision of each polygon to ensure biological accuracy. The wood turtle model is a stand-alone layer that is not used to value habitat patches.

The two principle differences between Version 1.0 and 2.0 are as follows: In Version 2.0, streams classified as 1st order or greater are included, while in Version 1.0 only streams classified by NJDEP as 2nd order and greater were included. This change was made based upon additional analysis following release of Version 1.0 that revealed a large number of documented wood turtle occurrences were on NJDEP 1st order streams, which were suitable for wood turtles.

In Version 2.0, only the identified wetlands together with the streams and stream buffers constitute wood turtle habitat, while in Version 1.0 any patches of upland forest, forested wetland, emergent wetland and grassland that intersected with the wetland and stream buffers were valued as wood turtle habitat. This change was made to limit the delineated habitat to those areas closest to suitable streams because the approach used in Version 1.0, included areas too distant from streams to be considered suitable for wood turtles. As a result of applying both of these changes, Version 2.0 values significantly less area as wood turtle habitat than Version 1.0.

## TECHNICAL INFORMATION

Critical areas maps are in ArcView shapefile format and projected to NJ State Plane feet, datum NAD 83, zone 4701. The maps are best viewed using ArcView 3.x or ArcGIS 8.x. These software products allow the user full functionality for viewing and manipulating critical area data. Non-GIS users can view the maps using ArcExplorer, a free GIS data browser that can be downloaded from the ESRI website:

http://www.esri.com/software/arcexplorer/aedownload.html

ArcExplorer allows the user to view GIS data, zoom in and out, perform simple queries and print maps.

**How to get critical areas maps:** Landscape Project data is available via download or viewing from the following NJDEP websites:

- http://www.nj.gov/dep/fgw/ensp/landscape/index.htm
- _www.njfishandwildlife.com
- Interactive ImapNJ website: http://www.state.nj.us/dep/gis/imapnj/imapnj.htm

or by contacting:
The Landscape Project
NJ Division of Fish and Wildlife
Endangered and Nongame Species Program
PO Box 400
Trenton, NJ 08625-0400
Phone:(609) 292-9400
Fax:(609) 984-1414

## HOW TO USE THE MAPS FOR ESTIMATING FRESHWATER WETLAND RESOURCE VALUE CLASSIFICATIONS

As noted above, the Department will be replacing the 1995 "area of documentation" guidelines (DEP 1995) with the habitat mapping provided in the ENSP Landscape maps. In an effort to facilitate the use of these data in estimating the resource value classification for a particular property, we offer the following guidance.

(a) When using the mapping, apply the following habitat coverages: emergent wetlands, forested wetlands, forest, grassland, wood turtle, urban peregrine falcon and bald eagle foraging;
(b) Locate your property within these coverages;
(c) Use the identity tool in the GIS application to determine whether or not any endangered or threatened species are present within any habitat coverage identified on your property;
(d) Determine if any delineated wetlands on or associated with the subject property fall within the boundaries of each of the habitat coverages (for example, forested wetlands within forest coverage, modified agricultural wetlands within the grassland coverage);
(e) Compare the characteristics of the onsite wetlands with the habitat discussions provided under the species descriptions below to see if the onsite wetlands may provide suitable habitat to one or more endangered or threatened species.
(f) If the onsite wetlands appear suitable for any of the "documented" species the wetlands may receive an exceptional resource value classification.

Please note that a formal freshwater wetland resource value classification can only be received from the NJDEP, Land Use Regulation Program through the issuance of either a wetland Letter of Interpretation or a Freshwater Wetland Permit.

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# SECTION 2

## SPECIES SPECIFIC HABITAT DISCUSSIONS: STATE AND FEDERAL ANIMAL SPECIES.

**Blue Spotted Salamander (*Ambystoma laterale*)**

**Status: State endangered**

New Jersey Distribution: Restricted to the prehistoric glacial lake basins occurring in Somerset, Morris, Essex, Warren and Sussex Counties. Former Glacial Lake Passaic, which occupies portions of Morris, Somerset and Essex counties (i.e. Great Swamp, Troy Meadows, Great Piece Meadows), appears to be the stronghold for the species. Great Meadows in Warren County and wetlands within Vernon Valley in Sussex County support localized populations.

NOTE: Since the Pleistocene blue-spotted salamanders have hybridized with Jefferson's salamander (special concern) creating a convoluted complex of hybrids that can only be accurately identified to the parent species through DNA analysis (Uzzell 1964). These hybrids were once assigned unique nomenclature i.e., Tremblay's salamander (*A. tremblayii*: two-thirds Jefferson and one-third blue-spotted) and silvery salamander (*A. platineum*: two-thirds blue-spotted and one-third Jefferson), but they are no longer recognized as valid taxa; instead hybrids are grouped within 'A. jeffersonianum-laterale complex' (Bogart and Klemens 1997). Since 1998 the NJ Division of Fish and Wildlife and the Wildlife Conservation Society has been mapping the various genetic patterns throughout the range of the blue-spotted and Jefferson salamander in New Jersey. To date, the results demonstrate that blue-spotted salamanders and their associated hybrids are restricted to the aforementioned locations. Jefferson and Jefferson-like hybrids are the dominant members of the A. *jeffersonianum-laterale* complex in the limestone sections of the Ridge and Valley/Highlands. Little range/habitat overlap between Jefferson and blue-spotted salamanders has not been documented; active hybridization of the two species is therefore not thought to be occurring.

**Habitat:**

Requires both aquatic and terrestrial habitat.

Breeding habitat: Breeding ponds occur primarily in swamps and marshes associated with bottomland floodplains. While woodland ponds are preferred breeding habitat, the species has also been documented to breed in drainage ditches (R.T. Zappalorti, pers. comm) and standing water within depressions in forested wetlands (Johnson 1988). Ponds are typically less than 10 meters (40 feet) in diameter, less than 1 meter (3 feet) in depth, feature muddy substrates, leaf litter and fallen twigs, and are frequently ephemeral (Johnson and Morin 1985).

Post-breeding habitat: Consists of the surrounding upland and wetland forest where individuals may be found under logs and other forest debris near the surface or in subterranean burrows (Anderson 1976; Zappalorti 1980; Johnson 1988). Dominant plant species included pin oak (*Quercus palustris*), black oak (*Quercus velutina*), northern red oak (*Quercus rubra*), red maple (*Acer rubrum*), black willow (*Salix nigra*) and gray birch (*Betula populifolia*) (Zappalorti 1980; Sciascia 1984). Soil types in the vicinity of capture sites included various types of sandy loams and 0-3% slopes (Zappalorti and Johnson 1988). Salamanders have also been found in refuse dumps amidst suitable habitat under asphalt shingles, broken bottles, and other natural and man-made debris (Stein 1990).

**Survey Methodologies:**

Blue-spotted salamanders move to breeding ponds during heavy rains in March and April. During breeding adults and/or eggs can be readily observed in ponds at night with the aid of a flashlight or headlamp. Minnow traps have been used successfully to capture salamanders in their breeding pond (Anderson and Giacosie 1967; E. Johnson, pers. comm.).

**Regulatory Guidelines:**

1. Area of documentation: Contiguous forest parcels associated with known breeding locales. See forest mapping discussion in Section 1. Within these habitat parcels, the classification process will focus on breeding pond habitats and wetlands within 305 meters (1000 ft).

2. Suitable habitat: Any pond meeting the criteria described in the habitat discussion above that is surrounded by sufficient upland/ wetland habitat within the 1000 foot "area of documentation." Surrounding habitat should be forested and feature one or more of the species described previously. It must be noted that as stated earlier, the species may also occur in atypical abitat (e.g. ditches, dump sites). As a result, in such situations, "suitable" habitat may deviate from the criteria described.

3. Special conditions: Any pond deemed to be a suitable habitat occurring within the species' New Jersey range, but for which no documentation exists, should be surveyed during the early spring of the year for salamanders.

**Rationale:**

Blue-spotted salamanders require additional upland and wetland habitat outside of their specific breeding habitat for survival. In order to preserve individual populations, additional protection of surrounding habitats is necessary to maintain sufficient non-breeding habitat for adult salamanders. The reliance on home range/movement data compiled for other species is appropriate due to the similarities in habitat usage amongst the *Ambystoma* genus in general, and, more speceifically, the genetic connection between the species of the *A. laterale-A. jeffersonianum* complex. The designation of all wetlands within a conservative home range will serve to protect sufficient habitat to maintain the documented population and to protect the topographic and drainage conditions which provide pond hydrology. Surveying suitable habitats will assist in preventing further loss of local populations of a species with a limited New Jersey range.

**Primary Authors**:

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**Name: Eastern Tiger Salamander (*Ambystoma tigrinum tigrinum*)**

**Status: State endangered.**

**New Jersey Distribution:**

Historically known from a coastal plain strip extending from near Bordentown in Burlington County to near Tom's River in Ocean County. Present populations are mainly concentrated in Cumberland and Cape May Counties.

**Habitat:**

Eastern tiger salamanders require both aquatic and terrestrial habitat.

Breeding habitat: The most productive breeding ponds observed in southern New Jersey were surrounded by oak (Quercus spp.)-pine (Pinus spp.) forest with sandy, gravelly soils. Willows (Salix spp.) were often present along pond edges. Assorted aquatic vegetation grew in ponds along with cattails (Typha spp.). Some sites featured sphagnum or star moss along the banks (Zappalorti 1980). Aquatic vegetation or brush is needed in the ponds for egg-attachment and stumps and logs on the bottom are desirable for cover (Zappalorti and Johnson 1981). Relatively clean, unpolluted water is essential to the larvae; ponds near agricultural areas may be adversely affected by spraying or fertilizing. Soil types at documented breeding ponds in Cape May and Salem counties included: Cape May County-Downer loamy sand (0-3% slopes); Fort Mott Sand (0-5% slopes); Salem County-Fallsington sandy loam (0-3% slopes); and Woodstown sand loam (0-5% slopes) (Zappalorti 1980). Breeding ponds in Delaware were 0.0003-4.7 ha. (0.00075-11.75 acres) in size, 0.5-1.6 meters (1.64-5.25 feet) deep, and had pHs of 5.5-7.8 (Arndt 1989). All ponds were at least partially surrounded by mature deciduous or mixed forest and featured substrates composed of firm sandy loams, sand and clay, or heavy organic mud.

Terrestrial Habitat: Due to their fossorial habits, there is little documentation associating tiger salamanders with any specific vegetative communities. Several authors have indicated that forested upland habitat is favored over agricultural or field habitats as post-breeding habitat (Semlitsch 1981; Clark 1988; Madison in Clark 1990). The great distance moved by the tiger salamanders studied by Biedermann (1988), from a breeding pond surrounded by agricultural fields to forested areas, would support these conclusions. Tiger salamanders have also been frequently captured in underground burrows (Semlitsch 1981; Semlitsch 1983; Madison 1990). Semlitsch (1983) recaptured a dispersing male tiger salamander in a pine plantation.

**Survey Methodologies**

The placement of fabric fences and pitfall traps around potential breeding ponds is the most frequently used methodology (Semlitsch 1983; Zappalorti 1990). In New Jersey adult salamanders migrate to breeding ponds on rainy nights from late October to February (Zappalorti pers. comm.). A second methodology often employed is to search for egg masses. In New Jersey, eggs are laid from late January to mid-March (Clark 1988). Eggs are found in clear to whitish masses attached to stem vegetation generally 0.6-1.3 meters (2-4 ft) below the pond

surface. Larval tiger salamanders may be identified after hatching (March-April) by entering the breeding pond and shining a flashlight through the water column (Zappalorti pers. comm.). Due to the seasonal and annual variability of their pond habitat, single-season surveys may not be indicative of the absence of a tiger salamander population.

**Regulatory Guidelines**:

1. Area of Documentation: Contiguous forest parcels associated with known breeding locales. See forest mapping discussion in Section 1. Within these habitat parcels, the classification process will focus on breeding pond habitats and wetlands within 305 meters (1000 ft).

2. Suitable habitat: Suitable breeding ponds typically feature:

a. water depths of a minimum of 0.5 meters through June;

b. at least one side of the pond or gravel pit complex should be forested or in the immediate vicinity of forested habitat;

c. forested dispersal corridors through lands surrounding the breeding site; and

d. low numbers or the complete absence of predators (e.g. fish, diving beetles).

It should be noted that exceptions to the criteria provided above do exist. The absence of one or more of these features will not automatically preclude the presence of the species and/or suitability of the habitat.

**Comments:**

While tiger salamanders are considered a site tenacious species, re-introductions of tiger salamander populations into created ponds using eggs have met with some success (Clark 1988).

**Rationale:**

Tiger salamanders require significant habitat outside of their breeding pond. In order to insure that sufficient wetland and upland habitat is available for the adult and dispersing population, wetlands outside of the immediate vicinity of the breeding pond need to be protected. In New York, buffers of 305 meters (1000 feet), consisting of a 103 meter (500 foot) radius to the breeding pond and an additional 103 meters (500 feet) in the form of dispersal corridors, are requested for documented tiger salamander habitats (Madison in Clark 1990).

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**Name: Wood Turtle (*Clemmys insculpta*)**

**Status State threatened.**

New Jersey Distribution: Historically, the wood turtle occurred throughout a range which included all of North Jersey, outside of Hudson County, and into South Jersey as far as Gloucester and Atlantic Counties. Like the bog turtle, this species now occurs in disjunct populations along particular drainages within its former range. Examples include the Wallkill and Paulins Kill Rivers (Sussex), the Ramapo River (Bergen), and the Passaic River (Morris and Somerset).

**Habitat:**

Wood turtles require both aquatic and terrestrial habitat. In New York, Burt and Collins (no date) found wood turtles to be mostly aquatic from mid-November to mid-March, mostly terrestrial from mid-May to mid-September, and in transition the remainder of the time. In Pennsylvania, Ernst (1986) stated that wood turtles were aquatic in the spring (April-May) and primarily terrestrial from mid-June to autumn. In New Jersey, wood turtles are primarily terrestrial from mid-May to October (Farrell and Zappalorti 1979; Zappalorti et al. 1984).

Aquatic habitat: In general, wood turtles use streams and rivers for breeding and hibernating. Riverine habitat in Wisconsin consisted of a river channel 3-5 meters (10-16 feet) in width and 0.3-1.5 meters (12-57 inches) deep and featured several oxbow backwaters and adjacent alder (*Alnus regosa*) thickets (Brewster and Brewster 1991).

Breeding occurs underwater, often in slow meandering streams with sandy bottoms and shoals in either the spring (April and May) or fall (September-October) ((Fisher 1945; Swanson 1952; Ernst and Barbour 1972; Harding and Bloomer 1979; Zappalorti and Farrell 1980; Farrell and Graham 1991). During hibernation, wood turtles are primarily found on the bottom or in the banks of waterways (Ernst and Barbour 1972; Carroll and Ehrenfeld 1978; Farrell and Zappalorti 1980; Strang 1983; Kaufman 1989). In Pennsylvania, Ernst (1986) found brumating wood turtles either on the stream bottom, buried to depths of 18-30 cm (7-13 inches) in soft substrate, or wedged under overhanging banks. These waterways were free flowing, 100-230 cm (40-92 inches) deep, and never froze completely. Farrell and Graham (1991) located a wood turtle hibernaculum at the bend of a stream under the roots of a large sycamore (*Platanus occidentalis*). Use of muskrat (*Ondatra zibethicus*) burrows for hibernation has also been reported (Carr 1952; Zappalorti et al 1984; S. Sweet, pers. comm. in Farrell and Graham 1991).

Wetland/terrestrial habitat: Outside of the activities described above, wood turtles make use of wetlands and uplands adjacent to their breeding/hibernating streams and rivers. The amount of use and characteristics of this habitat described in the literature is variable.

Carroll and Ehrenfeld (1978) reported wood turtle activity primarily in the wooded and marshy borders of streams. Stang (1983) found wood turtle activity predominantly confined to lowland, mid-successional forested areas dominated by oaks (*Quercus* spp.), black birch (*Betula lenta*) and red maple (*Acer rubrum*). Burt and Collins (no date) determined that wood turtles made far

greater use of aquatic, cornfield, and stream margin habitats than they did of successional field and woodland forest. Quinn and Tate (1991) established non-aquatic wood turtle habitat in Algonquin Park, Canada, to be predominantly alder thickets and mixed forests characterized by white and red pine (*Pinus strobus* and *Pinus resinosa*), poplar (*Populus* spp.), white birch (*Betula* p*apyrifera*), red maple (*Acer rubrum*), and red oak (*Quercus rubra*). Additional habitats identified in this study being used by wood turtles include grassy openings, upland pine plantations, deciduous forest, and lowland conifers. In New Jersey, Stein (pers. comm.) stated that his personal experience yielded wood turtles in floodplain associated areas a majority of the time, followed by upslope stream corridors and upland areas. Aside from the habitats described above, wood turtles may also bask in multi-flora rose (*Rosa multi-flora*) thickets (R.T. Zappalorti, pers. comm.).

**Survey methodologies:**

In New Jersey, wood turtles have been observed from March to December. Most captures have occurred in April-May and October, with 60% occurring between 11:00-13:00 hrs (Farrell and Zappalorti 1979). These data imply that stream side searches within these time frames are the most likely to produce results. Burt and Collins (no date) surveyed aquatic habitats by probing in stream bottoms, muskrat burrows, and beneath undercut banks. In Canada, Quinn and Tate (1991) principally found turtles by searching roads during May and June. In early June, female wood turtles are often observed in cultivated gardens and farm fields where they deposit their eggs (R. Stein pers. comm; Kaufmann 1992). Hatchling wood turtles have been found near such nest sites in September (R. Stein pers. comm.).

**Regulatory Guidelines**:

1. Area of documentation: Refer to *DETAILED METHODOLOGY FOR DELINEATING CRITICAL HABITAT AREAS FOR THE WOOD TURTLE IN SECTION ONE.*

2. Suitable habitat: Due to this species' highly variable habitat uses, it is difficult to qualify particular characteristics which define a suitable habitat. In field evaluation, characteristics which affect the suitability of a particular habitat include:

a. streams or rivers featuring flowing water of varying depths, undercut banks, muskrat burrows, fish populations, and evidence of good water quality. Potential barriers to wood turtle movement (e.g. road crossings, lakes) along a particular stream corridor also affect habitat suitability;

b. favored adjacent upland/wetland habitats are characterized by mosaics of forest, field, shrubs, and agricultural lands, though wood turtles also occur in more monotypic areas. Thickets of alder, greenbriar (*Smilax* spp.), or multi-flora rose adjacent to aquatic habitats are favored basking areas; and

c. the availability of food species including invertebrates, tadpoles, earthworms, black and raspberries, violets, fungi, willow (*Salix* spp.) leaves and carrion (Kaufman 1986, Farrell and Zappalorti 1980, Farrell and Graham 1991).

**Comments:**

Wood turtles are often found in association with other Clemmys species and trout waters (Zappalorti and Johnson 1981, Ernst 1986, Farrell and Graham 1991). They are also good climbers and have been documented to scale 1.8 meter (6 foot) chain-link fences (Behler and King 1979).

**Rationale:**

Wood turtles are an extremely mobile species which have been documented to move at least 1.8 kilometers (1 mile) along a stream corridor and exhibit familiarity with wetland habitats 2 kilometers (1.2 miles) from an initial capture point. In addition, wood turtles require additional upland/wetland habitats outside of their aquatic habitats. Establishment of a minimum of 3.7 kilometers (2 miles) "area of documentation" along portions of stream corridor/wetland complexes known to feature wood turtles ensures that sufficient aquatic and terrestrial habitat is preserved for this species.

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**Name: Bog Turtle (*Clemmys muhlenbergii*)**

**Status: Federally threatened, state endangered.**

**New Jersey Distribution**:

Historically, bog turtle range extended into virtually every county but Hudson. Species is considered extirpated or historical in Bergen, Camden, Cape May, Mercer and Middlesex counties (USFWS 2001) Present distribution is reduced and disjunct, with populations being clustered within particular drainages. Examples include the Manasquan River (Monmouth), Papakating Creek (Sussex), the Passaic River basin (Morris), and Raccoon Creek (Gloucester).

**Habitat:**

Bog turtles are associated with bogs, swamps, ponds, grazed meadows and other wetlands that support moisture-loving plants and which feature an abundance of grassy or moss cover (Carr 1952; Barton and Price 1955; Campbell 1960; Nemuras 1965; Ernst and Barbour 1972; Kiviat 1978; Chase et al. 1989). Seep bogs may feature rust-colored iron-oxide deposits (Arndt 1977). An open canopy is also frequently cited as a characteristic of suitable bog turtle wetlands (Boyer 1965; Zappalorti 1979; M. Klemens in DeGraff and Rudis 1986). Outside the these "typical" habitats, bog turtles may also utilize more densely vegetated areas for hibernation and may be incidenttally found in a wide variety of habitats when making relatively long-distance movements (Buhlmann et al. 1997 in USFWS 2001, Carter et al. 1999 in USFWS 2001, Morrow et al. 2001 in USFWS 2001). Breich (1986) reported one female bog turtle in New York to inhabitat a red maple swamp, only moving to an open meadow habitat to lay eggs.

In Maryland, Taylor et al. (1984) documented over 200 bog turtle colonies during their studies. All sites were sedge meadows with the majority being less than 2 acres in size. Of the 67 species of herbaceous plants found on these sites, the following species were the most dominant; tussock sedge (*Carex aquatilis*), rice cut grass (*Leersia oryzoides*), tearthumb (*Polygonum sagittatum*), arrowhead (*Sagittaria* spp.), skunk cabbage *(Symplocarpus foetidus*), soft rush (*Juncus* spp.), and various grasses and sedges. Further analysis of Maryland bog turtle colonies indicated that the greater the population density, the more likely the site was to be:

a. located in a circular basin;

b. feature spring-fed pockets of shallow water;

c. a bottom substrate of soft mud or rock;

d. dominant vegetation of sedges and grasses; and

e. interspersed wet and dry pockets (Chase et al. 1989)

Of 132 turtles captured, 51 were out of the water, 81 in the water. Of the 81 captured in the water, 72 were found in water < 8 cm deep, and 77 were found < 10 cm from vegetation.

Arndt (1977) characterized bog turtle habitat in Delaware as featuring a substrate of deep mud, numerous small springs, constantly flowing clear and relatively cool water, networks of rivulets, shallow pools, and muskrat (*Ondatra zibethicus*) runways, and an open canopy. Dominant meadow species included rice cut-grass (*Leersia oryzoides*), arrow-leaved tearthumb (*Polygonum sagittarium*), halberd-leaved tearthumb (*P. arifolium*), spotted touch-me-not (*Impatiens capensis*), skunk cabbage (*Symplocarpus foetidus*), sensitive fern (*Onoclea sensibilis*), bullrush (*Scirpus* spp.), and asters (*Aster* spp.).

In New Jersey, Zappalorti and Zanelli (1978) listed the following species as those commonly found in wetlands featuring bog turtles: red maple (*Acer rubrum*); alder (*Alnus* spp.); willow (*Salix* spp.); watercress (*Cardamine rotundifolia*); pondweed (*Potamogeton* spp.); sphagnum moss (*Sphagnum* spp.); sundew (*Drosera rotundifolia*) skunk cabbage; smartweed; jewelweed; goldenrod (*Solidago* spp.); cinnamon fern (*Osmunda cinnamonea*); day lily (*Hemerocallis fulva*); and swamp rose (Rosa *palustris*). Warner (1985) reported many of the plants discussed above as well as cattail (*Typha latifolia*) and pitcher plants (*Saracenia purpurea*) from a bog near Lafayette. In Sussex and Warren Counties, bog turtles occur almost exclusively in limestone associated, calcareous fens. These fens possess unique calcicolous plant communities comprising herbaceous species such as *Carex sterilis, C. flava, Scleria verticillata, Parnassia glauca, Selaginella apoda, Sarracenia purpurea, Deschampsia caespitosa* and low growing shrubs including *Rhamnus alnifolia, Ribes hirtellum, Pentaphylloides floribunda,* and *Rhus vernix. Juniperus virginiana* and *Larix larcina* are often scattered in these fens but are usually dwarfed, presumablly due to low nutrient levels (Boyer and Wheeler 1989).

Hibernacula: Ernst et al. (1989) studied 44 hibernacula sites in Pennsylvania and New Jersey. Hibernating bog turtles were found in soft stream bottoms (19), muskrat burrows (12), at the base of sedge clumps (2), at the base of a cedar stump (5), and in meadow vole burrows (6). Turtle depth below water and mud varied from 5-55 cms. In Massachusetts, Klemens (1993a in USFWS 2001) reported many early season captures were concentrated on or near shrubby hummocks that served as hibernacula at the interface zone between open fen habitats and shrub and wooded swamp. These hummocks were covered with small trees and shrubs with springs percolating up around them. Hibernating turtles have also been found under water in soft mud, in crevices between rocks or between tangled roots (USFWS 2001). Bog turtles may use hibernaculum annually.

**Survey methodologies:**

In New Jersey, bog turtles are active from early April into November, with most captures occurring from May into August (Zappalorti and Zanelli 1978; J. Sciascia pers. comm.). Their survey techniques consisted of:

1. Visually scanning the muddy streams, muskrat runways, seepage ditches, grassy stream banks, and sedge tussocks for basking or foraging turtles;

2. Probing in the mud of rivulets with a four-foot probing stick; and

3. Feeling underneath tussocks or into muskrat holes with hands and feet.

Surveys conducted in the early spring (April-May) before vegetation leaf-out on clear to mostly sunny days with air temperatures at or above 21 C (70 F) offer a greater chance for success in identifying the species. Activity patterns suggest that surveys conducted during the morning hours (0600-0900 hrs) may be more productive than those conducted later in the day. While no consensus on the survey effort necessary to determine the absence of bog turtles from a site has been reached, a minimum of five visits by an experienced herpetologist of between 1-2 hrs each has been suggested (R. Arndt, pers. comm.; R.T. Zappalorti, pers. comm.).

Gemmell (1989) sectioned wetlands in 20 by 20 meter grid and used six baited funnel traps to capture bog turtles. Traps must be partially submerged in water and should be checked daily and moved every 3-5 days. Caution should be taken using this survey option since trapped turtles are susceptible to predation by raccoons. J. Sciascia (pers. comm.) trapped turtles in New Jersey using drift fence/eel trap networks within suitable habitat.

In general, no current survey methodology has been demonstrated to consistently yield accurate results in establishing the presence, absence, or viability of populations of the bog turtle. D. Gemmell (pers. comm) indicated that many variables including vegetation density, water levels, weather, expertise of surveyor, and population density will impact the success of a particular survey effort in a particular wetland and he does not recommend his techniques for use in all wetlands.

**Regulatory Guidelines:**

1. Area of documentation: Refer to Appendix 1, Section I above.

2. Suitable habitat: spring fed meadows or bogs featuring emergent vegetation and/or successional vegetation species identified above. Portions of the bog must feature water levels, streams, or rivulets which maintain continuous flows of 1-8 cms in depth.

**Rationale:**

A study commissioned by the NJDEPE suggested that out of 75 known bog turtle wetlands, only 24 continued to feature suitable habitat (Zappalorti and Farrell 1989). Many of these sites were believed victims of development, stormwater discharges, and/or natural succession. More extensive surveys conducted by the Department from 1993-2000 found 165 potential habitats, less that half (72) of which were considered viable (USFWS 2001). The Department believes that to ensure the long-term protection of these sites, there is a need to establish an exceptional resource value classification for both the “core” habitat and additional wetlands interconnected with the "documented" wetland. This additional protection is justified by:

a. the successional nature of existing habitats and the potential that current habitats will become unsuitable in the future;

b. the requirement of the species of groundwater/spring-fed waters;

c. studies that suggest that the species may room more widely that previously thought; and

d. the necessity to maintain connection to other bog turtle populations and/or suitable habitats to allow for gene exchange between populations and immigration or emigration of turtles or colonies as successional changes occur to the wetland habitat.

**Comments:**

In addition to the direct protection provided to bog turtle habitats under an exceptional classification, the Department will also look carefully at Statewide General Permit activities proposed for such areas. Due to the sensitive nature of these habitats, even minor impacts such as a road crossing or stormwater discharge may have adverse affects (Torok 1994). In addition, due to a variety of concerns including groundwater recharge and contamination, the USFWS may request wetland buffers in excess of 150 feet in certain instances.

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**Name: Timber Rattlesnake (*Crotalus horridus*)**

**Status: State endangered. Proposed federal candidate (C2).**

**New Jersey Distribution:**

Two disjunct populations. North Jersey population occurs on rock out-croppings and talus slopes along the Kittatinny Ridge and other mountainous areas of Sussex, Morris, Warren, Passaic, and Bergen Counties. South Jersey populations historically occurred in the pine barrens and fringe areas in Monmouth, Cumberland, Ocean, and Burlington Counties. Presently only known to be extant in Burlington and Ocean County.

**Habitat:**

Timber rattlesnakes require both upland and wetland habitat. In a New Jersey pine barrens study, the typical random habitat site in the study area was characterized as forested with better than 50% canopy closure, dense surface vegetation (approx. 75% closure), and dead and down material. Preferred habitat for gravid females was open (approx. 25% canopy closure) areas featuring fallen logs and even mixed leaf litter/vegetated ground cover (Reinhart and Zappalorti 1988a and 1988b). South Jersey populations are commonly associated with Lakewood, Woodmansie, and Lakehurst soils.

Hibernaculums occur in sphagnum hummocks undermined by running water which maintains a critical micro-climate for the snakes. While in hibernation the snakes were found to coil themselves among tree roots in the water table in Atlantic white cedar (*Chamaecyparis thyoides*) swamps (Reinhart and Zappalorti 1988a). Timber rattlesnakes have also been reported to hibernate near seepage springs under sphagnum moss (Kauffeld 1957; Zapparlorti 1980). Typical vegetation at New Jersey den sites included pitch pine (*Pinus rigida*), several oak species (*Quercus* spp.), short-leaf pine (*Pinus echinata*), virginia scrub pine (*Pinus virginiana*), *Smilax,* low-bush blueberry (*Vaccinium vacillans*), high-bush blueberry (Vaccinium corymbosum), pitcher plant (*Sarracenia purpurea*), and sundews (*Drosera* spp.) (Zappalorti 1980).

In north Jersey, timber rattlesnakes use communal den sites located in rock outcroppings and talus areas along the major ridges of the Ridge and Valley and Highlands physical provinces. Rattlesnakes disperse away from the den and use primarily forested habitats within a 3.3 kilometer (2 mi) radius of the den during summer months (R. Stechert, pers. comm.). Wetlands within the summer habitat of the north Jersey populations are used in varying degrees depending on the type of wetland habitats present, the percentage of total summer habitat comprised by wetlands, and the location of the wetlands relative to the den site (J. Sciascia, pers. comm.)

**Regulatory Guidelines:**

Due to differences in habitat usage, wetland protection strategies must be applied differently to the north and south Jersey populations.

1. North Jersey: Timber rattlesnake populations in this portion of the state are predominantly found in association with rocky mountain slopes located around den sites. While, hibernaculums occur in upland talus slope/forest areas, rattlesnakes disperse away from the den site and use predominantly forested habitats including forested wetlands during the summer months. The establishment of an "area of documentation" will be done on a case by case evaluation of the Department's information on each individual regional population integrating home range data and location/ sightings reports. Suitability will be determined largely by proximity of sightings, distance from den site, wetland habitat type and surrounding land uses.

2. South Jersey: Timber rattlesnake populations in this portion of the state are highly dependent on wetland habitats due to their use of such habitats for hibernation. Maintenance of water volume and flow in streams and wetlands providing denning habitat is essential to ensure a stable micro-climate and maintain regional rattlesnake populations. Wetlands which are directly associated with the wetland/stream corridor complex featuring a den site will be considered a "documented" habitat, the extent of which will be determined on a case by case basis. Additional wetlands within a 3.3 kilometer (2 mi) radius will be evaluated for use for "resting or feeding" by rattlesnakes. Suitability will be determined largely by proximity of sightings, distance from den site, wetland habitat type and surrounding land uses.

Also refer to Appendix 1, Section I above for additional guidance.

**Comments:**

Rattlesnakes are susceptible to severe collecting pressure. Den location information is of an extremely sensitive nature. Extant south Jersey populations predominantly, if not exclusively, occur on land within the jurisdiction of the Pinelands Commission.

**Rationale**

Timber rattlesnakes are listed as endangered in New Jersey and there is serious concern about the northeast populations in general. Protection of likely feeding and dispersing areas in North Jersey is necessary to maintain tracts of suitable habitat in the vicinity of den sites, and also, to minimize human and snake interactions. South Jersey populations are dependent on wetland habitats to maintain suitable hibernaculum microclimates and also to provide sufficient resting and feeding habitats.

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**Name: Long-tailed Salamander (*Eurycea longicauda*)**

**Status: State threatened**

**New Jersey Distribution:**

Commonly associated with limestone regions of the State, primarily in Sussex and Warren Counties. Also recorded from Hunterdon, Mercer, Morris, Passaic, Somerset, and Union Counties.

**Habitat:**

Long-tailed salamanders require wetland and upland habitats.

Aquatic habitat: Long-tailed salamanders are somewhat catholic in their habitat requirements being recorded from shale banks, springs, spring runs, river sides, floodplains, caves and mines and streams in Hunterdon County (Anderson and Martino 1966; Stein 1992). In New Jersey, the species is also frequently found in vernal ponds and sinkholes in limestone areas of Warren and Sussex counties (Anderson and Martino 1966; Zappalorti and Reap 1983) and in streams in Hunterdon and Somerset Counties (R. Stein, pers. comm.).

Ponds studied in Sussex county were characterized by their association with Kittatinny limestone either in out-croppings or boulders, widely varying water depths (1.5-1.8 meters; 5-6 feet in the spring, dry by mid-summer), size (0.5-5.5 hectares; 1.3 to 13.8 acres), and forested uplands featuring silver maple (*Acer saccharinum*), chestnut oak (*Quercus prinus*), red oak (*Quercus rubra*), white oak (*Quercus alba*), sugar maple (*Acer saccharum*), shag-bark hickory (*Carya ovata*), walnut (*Juglans nigra*), sycamore (*Platanus occidentalis*), willows (*Salix* spp.), and ashes (*Fraxinus* spp.) (Anderson and Martino 1966). The species has also been observed in iron mines and spring houses (Anderson and Martino 1967; M. Rapp pers. comm.)

In a survey of 59 sites in northern and central New Jersey, Stein (1992) evaluated the vegetational communities at occupied sites. Overstory species typically found included red maples (*Acer rubrum*), White ash (*Fraxinus americana*), sycamore, American elm (*Ulmus americana*), white oak, tulip poplar (*Liriodendron tulipifera*), and hemlock (*Tsuga canadensis*). Shrub layers consisted of arrowwood (*Viburnum recognitum*), alder (*Alnus* spp.), ironwood (*Carpinus caroliniana*). various saplings, poison ivy (*Rhus radican*), and spicebush (*Lindera benzoin*). Herbaceous vegetation was dominated by jewelweed (*Impatiens camprensis*), smartweed (*Polygonum* spp.), grasses, and ferns.

Terrestrial habitat: Anderson and Martino (1966) report finding adult long-tailed salamanders under rocks, bark, and logs under the forest canopy during the day. During nocturnal hours, salamanders were observed crawling atop of their daytime habitats as well as up tree trunks. Sciascia (1989) found salamanders in similar habitats as well as crevices in vertical rock faces and noted that forest parameters did not appear to limit abundance. R. Stein (1992) indicated that a closed forest canopy appeared to be an essential characteristic of all stream/pond habitats

he investigated. Long-tailed salamanders have also been found in a man-made tunnel and in a dried up well (R. Stein, pers. comm.)

**Survey methodologies**

Analysis of survey efforts indicates that the periods of April-June and August-September resulted in the most observations. Anderson and Martino (1966) collected larval long-tailed salamanders by sweeping a net through leaf litter and dead vegetation in the shallowest portions of ponds. Early spring collections were more successful than later attempts due the growth of aquatic vegetation and dispersal of larvae throughout the pond. Stein (pers. comm.) surveyed historic sites by using a metal-hooked broom handle to flip rocks and logs. Sites were visited a minimum of two times during the periods described above, but he cautioned that additional visits would frequently be necessary to confirm the absence of the species from apparently suitable habitats. Long-tailed salamanders may also be identified at night by searching rock outcrops with a flashlight (Stein 1992).

**Regulatory Guidelines:**

1. Area of documentation: For pond habitats, the pond and contiguous wetlands necessary for the maintenance of the complex hydrology. For stream habitats, all corridor contiguous wetland habitats within a 0.5 mi. radius of the documented site will be considered documented habitats. Stream alterations, such as ponds or dams, may affect the extent of this "area" in some instances.

2. Suitable habitat: In most cases, the presence or absence of the species will factor significantly in the "suitability" of a habitat. Pond and steam corridor habitat characteristics to be evaluated include:

a. good water quality, noting indicators of water quality such as invertebrate fauna, other salamander species, algae growths, stormwater outfalls, pH, etc.;

b. limestone formation association; and

c. shading from forest canopy along 50% of pond/stream border featuring one or more of the species identified above.

**Comments:**

Habitat and life history not well defined in the literature. The association of New Jersey's long-tailed salamanders with limestone formations is apparently unique within the species' range.

**Primary Authors**

Larry Torok, Land Use Regulation Program

DRAFTDATE: 08/08/94 UPDATE: 08/08/94

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**Name: Pine Barrens Treefrog (*Hyla andersonii*)**

**Status: State endangered**.

**New Jersey Distribution:**

Occurs throughout the Pine Barrens in Ocean, Burlington, and Atlantic Counties. Smaller populations recorded from Monmouth, Camden, Gloucester, Cumberland, and Cape May Counties. Believed extirpated from Middlesex County. Species has a disjunct range, with other populations occurring in North Carolina, South Carolina, Florida, Georgia, and Alabama.

**Suitable Habitat:**

Pine Barren Treefrog`s require wetland and terrestrial habitats.

Breeding habitat: Pine Barrens treefrogs have been generally reported to breed in seepage bogs, cranberry bogs, small and ephemeral ponds, streamlets, Atlantic white cedar (*Chamaecyparis thyoides*) swamps, and pitch pine (*Pinus rigida*) lowlands (Means and Longden 1976; Hulmes et al 1979; Cely and Sorrow Jr. 1986). Treefrogs have also been reported to colonize disturbed habitats, such as wet areas within power and gas ROWs, borrow pits, and vehicle ruts, if suitable shrub and herb vegetation is present (Freda and Morin 1984). Because breeding commences later in the season (May-June), Pine Barrens treefrogs typically make use of sites in which ponded hydrologic conditions persist through August, allowing time for metamorphosis of larva.

Based on an analysis of 40 sites in New Jersey, North Carolina, South Carolina, and Florida, and 13 sites in the New Jersey Pinelands [(Freda and Morin, 1984), (Laidig, Zampella, Bunnell, Dow and Sulikowski, 2001), respectively], typical suitable pine barren treefrog habitat has been described as:

1. areas featuring an open canopy with overstory density ranging from 0-112 trees per 100 square meters;

2. shrub understory average height of 1.6 meters;

3. shrub stem density average of 32 stems per meter (approx. 50% foliage cover);

4. pond depths averaged approx. 1 meter (0.1->2 meters) and;

5. waters with a pH of between 3.8 and 4.6.

Plant species reported from treefrog breeding sites include: sphagnum moss, sundews (*Drosera* spp.); various sedges (C*arex* spp.), rush's (*Eleocharis and Rhynchospera spp*.), grasses (*Panicum spp*.), wool grass (*Scripus cypernus*), pitcher plants (*Sarracenia purporea*); orchids (*Platanthera* spp.); Atlantic white cedar; pitch pine; mountain laurel (*Kalmia latifolia*); high-bush blueberry (*Vaccinium corymbosum*); swamp azalea (*Rhododendron viscosum*); sheep laurel (*Kalmia angustifolia*); leatherleaf (*Chamaedaphne calyculata*), black-jack oak (*Quercus marylandica*);

magnolia (*Magnolia virginiana*); greenbriar (*Smilax* spp.); maples (*Acer* spp.); and sweet pepperbush (*Clethra alnifolia*) (Means and Longden 1976; Hulmes et al. 1980; Freda and Morin 1984).

Terrestrial habitat: Treefrogs move into upland areas adjacent to breeding ponds during July and August. The species has been identified calling from pitch pines, cedars, oaks (*Quercus* spp.), and highbush blueberry thickets (Hulmes et al. 1980). Isotope-tagged frogs were found on the ground, under leaf litter, and calling from vegetation (Freda and Morin 1984).

**Survey methodologies**

Male treefrogs may be identified by their call from mid-May to August. It is recommended that surveys be conducted during warm (70 F.+), humid or rainy nights in May and June and that a control population be used to evaluate the suitability of weather conditions. Taped calls of treefrog calls may be used to elicit responses. Recent studies have also investigated the use of artificial refugia (PVC pipe) as a survey methodology for Hylid treefrogs (Boughton, Staiger and Franz, 2000) which may be less seasonally dependant.

**Regulatory Guidelines:**

1. Area of documentation: Contiguous forest parcels associated with known breeding locales. See forest mapping discussion in Section 1. Within these habitat parcels, the classification process will focus on breeding pond habitats and wetlands within 305 meters (1000 ft).

2. Suitable habitat: Wetland habitats consistent with the structural, chemical, and vegetative characteristics described above.

**Rationale**

Suitable breeding habitat for Pine Barrens treefrogs is ephemeral in nature, being subject to annual variations in rainfall and the effects of succession. Pine Barren treefrog breeding populations have demonstrated the ability to colonize suitable habitat within contiguous wetland complexes. As a result, the protection of additional wetland and upland areas outside of the immediate vicinity of the individual breeding ponds is necessary to provide for the long term continuation of a breeding population. In addition, the establishment of upland buffers of 46 m (150 ft) serves to provide some of the species' upland habitat requirements while minimizing impacts to wetland hydrology and pH.

**Primary Author(s)**

Larry Torok, Land Use Regulation Program

DRAFTDATE: 08/08/94 UPDATE: 02/11/04

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**Name: Southern Gray Treefrog (*Hyla chrysoscelis*)**

**Status: State endangered.**

**New Jersey Distribution:**

Presently known only to occur in Atlantic, Cape May and Cumberland Counties, and Ocean Counties

**Suitable Habitat:**

Southern gray treefrogs require wetland and terrestrial habitats.

Breeding habitat: Southern gray treefrogs have been reported to breed in gravel pits, natural woodland ponds, and shrubby wooded farm ponds in New Jersey and to use swamps, bogs, ponds, weedy lakes, and roadside ditches elsewhere (Zappalorti and Hulmes 1980; DeGraaf and Rudis 1981). A breakdown of 80 confirmed sites in southern New Jersey yielded 26 man-made borrow pits, 23 natural vernal ponds, 22 stream floodplain corridors, 5 retention/detention ponds, and 4 man-made pond/lakes (Zappalorti and Dowdell 1991b). Farm pond breeding ponds are described as stream fed waters which are grazed by livestock. Farm pond sites often had few or no trees but low shrubs and bushes were always present along the periphery (Zappalorti and Hulmes 1989).

Habitat evaluations conducted by Zappalorti and Dowdell (1991a) of 50 breeding pond sites in southern New Jersey revealed the following plant community associations:

a. Overstory species: scarlet oak (*Quercus coccinea*), willow oak (*Quercus phellos*), white oak (*Quercus alba*), scrub oak (*Quercus ilicafolia*), blackjack oak (*Quercus marilandica*), red maple (*Acer rubrum*), sweet gum (*Liquidambar styraciflua*), black gum (*Nyssa sylvatica*), swamp willow (*Salix nigra*), pitch pine (*Pinus rigida*), short leaf pine (*Pinus echinata*), Virginia pine (*Pinus australis*) and American holly (*Ilex opaca*);

b. Understory shrub species: buttonbush , huckleberry, highbush blueberry (*Vaccinium corymbosum*), alder (*Alnu*s spp.), inkberry (*Ilex glabra*), catbriar or *Smilax,* cattail (*Typha latifolia*), and phragmites; and

c. ground cover species: sphagnum moss, star moss, club moss, sundews (*Drosera rotundifolia*), pitcher plants (*Saracenia purpurea*), and various forbs and grasses.

Hardwood forest occurred next to every confirmed breeding pond, with the overstory canopy being within 25 feet of the water's edge. A study in Tennessee found documented breeding ponds to be dry during parts of June, July, and August (Ritke et al. 1991). Adult male treefrogs often remained at breeding pond sites during dry spells.

Terrestrial habitat: Gray treefrogs move over land between ponds during the breeding season (Ritke et al. 1991), and adult northern gray treefrogs (Hyla versicolor) have been documented

traveling as far as 200 meters from a central breeding pool during the breeding season to oviposit in adjacent available sites (Johnson and Semlitsch 2003). Treefrogs move into upland areas adjacent to breeding ponds during July and August. During the summer months, treefrogs have been found in moist areas of hollow trees, under loose bark, and in rotted logs (DeGraaf and Rudis 1981). Calling treefrogs have been identified at ground level and high in trees (Behler and King 1979; Zappalorti and Hulmes 1980). Zappalorti and Dowdell (1991a) reported treefrogs calling from willows, oaks, pitch pines, maples, holly, and cedars adjacent to breeding ponds.

**Survey methodologies**

Male treefrogs may best be identified by their call from early May through July near breeding ponds. Zappalorti and Dowdell (1991a) conducted random nocturnal road surveys to identify previously undocumented breeding ponds. Surveys were conducted by driving at slow speeds (25-30 mph) using a team of one or two people to listen for calling frogs. To reconfirm known sites taped calls were used to solicit responses. Favorable weather conditions for surveys include temperatures above 70 F., humidity levels above 60 %, and winds at 5 mph or less. Recent studies have also investigated the use of artificial refugia (PVC pipe) as a survey methodology for Hylid treefrogs (Boughton, Staiger and Franz, 2000) which may be less seasonally dependant.

**Comments:**

Southern gray treefrogs are visually indistinguishable from the more common Northern gray treefrog (*Hyla versicolor*). Both species occur in Atlantic, Cumberland, and Cape May counties. Southern grays can be differentiated from Northern gray treefrogs by analysis of blood cell size, and chromosome number. The species may also be distinguished by variations between their calls, with Southern gray treefrogs having a faster trill. Caution should be used in trying to differentiate between the species by call without sonogram analysis because at low temperatures both species may sound identical.

**Regulatory Guidelines:**

1. Area of documentation: Contiguous wetlands within a 0.44 kilometer (0.25 mi.) radius of a documented breeding pond. Larger portions of contiguous wetland complexes will be considered in situations where two or more breeding ponds are within 0.83 km (0.50 mi.) of each other.

2. Suitable habitat: Wetland habitats consistent with the structural, and vegetative characteristics described above.

**Rationale**

Suitable breeding habitat for southern gray treefrogs is ephemeral in nature, being subject to annual variations in rainfall and the effects of succession. Southern gray treefrog breeding populations have demonstrated the ability to colonize suitable habitat within contiguous wetland complexes and also to move between breeding ponds during the breeding season. As a result,

the protection of additional wetland and upland areas outside of the immediate vicinity of the individual breeding ponds is necessary to provide for the long term subsistence and genetic viability of a breeding population. In addition, the establishment of upland buffers of 46 meters (150 feet) serves to provide some of the species' upland habitat requirements while minimizing impacts to wetland hydrology and movement corridors.

**Primary Author(s)**

Larry Torok, Land Use Regulation Program

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**Species: Eastern Mud Salamander (*Pseudotriton montanus montanus*)**

**Status: State endangered.**

New Jersey Distribution: Only verified from one location in Burlington County. Unconfirmed sightings reported from Atlantic, Burlington, and Ocean Counties. Apparently restricted to wetlands in south Jersey.

**Habitat:**

Mud salamanders inhabit muddy or mucky microhabitats in or along margins of swamps, bogs, springs, floodplain forests, and small headwater tributaries (Conant 1975; Petranka 1998). Adults and juveniles usually remain within 20 meters of the breeding pond under woody cover or in burrows, though some reports of individuals being found further away exist (Barbour 1957 in Petranka 1998; Bruce 1975 in Pretranka 1998). The single confirmed record for New Jersey occurred in a vegetation-choked ditch in a fallow cranberry bog (Conant 1957). Several authors suggest that the species requires good water quality (Cromartie 1982; NJDEP and US Soil Conservation Service 1986).

**Survey Methodologies**

No specifics provided in the literature. Systematic searches of potential habitat by looking under rocks, logs, and decaying vegetation, and in muddy streambank burrows.

**Regulatory Guidelines:**

1. Area of Documentation: Wetlands featuring a documented sighting of the species.

2. Suitable habitat: Little specifics provided. See discussion of habitat above.

Due lack of information on the species home range and habitat requirements, designation of exceptional resource value wetlands will have to be done on a case by case basis.

**Comments:**

Present information concerning distribution of species in New Jersey is inadequate. Species may be confined to the Pine Barrens.

**Rationale**

Due to the lack of information on the distribution of this species in New Jersey and its habitat/home range, firm guidelines on designating exceptional resource value wetlands based on sightings of this species can not presently be determined. As a result, the Department will determine the extent of exceptional resource value wetlands based on sightings of this species on a case by case basis.

**Primary Author(s):**

Larry Torok, Land Use Regulation Program

DRAFTDATE: 08/08/94 UPDATE: 07/17/02

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**Species: Henslow's sparrow (*Ammodramus henslowii*)**

**Status: State endangered**

**New Jersey Distribution**:

Always rare and occurring in disjunct populations, Henslow's sparrow historically was known from southern Sussex, Middlesex, and Mercer counties as well as along the Delaware Bay shore. Recent sightings come from Morris, Ocean, Hunterdon, and Bergan counties. The last documented breeding occurrences were outside of Princeton in 1972 and at the Lakehurst Naval Air Station in 1994 (Walsh et al. 1999)

**Habitat:**

Henslow's sparrow will use a variety of early successional habitats with no definitive preference being shown for wetlands or uplands (Hyde 1939; Bull 1974). Robins (1971) suggested that the species preferred an intermediate moisture regime, avoiding areas which were "too wet" or "too dry". Other studies suggesting use of wet areas by Henslow's sparrow come from New York (Peterson 1983), Connecticut (Craig 1979), Vermont (Kibbe and Laughlin 1985), and Massachusetts (Forbush 1929).

Structurally, sites featuring Henslow's sparrow are dominated by sedges (*Carex* spp.), rushes (*Scirpus* spp.), grasses, and other non-woody vegetation (Wiens 1969; Peterson 1988). Others have suggested that some level of shrubby vegetation occurs as a component of occupied habitats (Whitney et al 1978; Johnsgard 1979; Fall and Eliason 1982). In Kansas, herbaceous vegetation ranged in height from 30-50 cm. (10-20 in.) within breeding territories (Zimmerman 1988). Herkert (1994) found occupied sites in Illinois to feature a greater density of low vegetation [< 25 cm. (10 in.)] and more standing dead vegetation than unoccupied sites. Wiens (1969) identified use of shorter grass sites for foraging. Other characteristics of Henslow sparrow habitat include a layer of ground litter (Wiens 1969; Robins 1971; Fall and Eliason 1982) and dead standing vegetation (Zimmerman 1988).

**Survey methodologies:**

No specific techniques have been developed to survey for Henslow's sparrow. Aural listening in suitable habitats and/or use of tape calls to elicit responses from territorial birds have been suggested (Zimmerman 1988). Nests may be located by dragging a heavy rope between two people through suitable habitat with one or two people walking behind looking for flushed birds (M. Valent, pers. comm.). Hanson (1987) advised walking through suitable habitats during the nesting season (mid-April through June) rather than conducting surveys from the road. Several years of data is recommended over single season surveys (Hands et al. 1989).

**Regulatory Guidelines**:

1. Area of documentation: Due to the species subtle habitat requirements, use of both upland and wetland habitats, and apparent need for habitat complexes much larger than an

individual home range, the establishment of the extent of wetlands to be evaluated in regard to their suitability for this species will be done on a case by case basis. In establishing the extent of wetlands covered under this determination, the Department will weigh the continuity of suitable wetland habitat with evidence suggesting that the species may require wetland habitat complexes up to 100. ha (250 ac.) in size.

2. Suitable habitat: Wetlands suitable for use by Henslow's sparrow can be characterized as:

a. marshes, meadows, or wet fields which are not saturated, flooded or ponded;

b. emergent areas featuring a predominance of sedges, rushes, and/or grasses; and

c. a sparce shrub community of 1-2 meters (3.28-6.5 ft.) in height.

**Rationale**

Henslow's sparrow is highly dependent on a sensitive wetland hydrologic regime and successional vegetative community. Habitats which become too wet or too dry are abandoned. Habitats which change due to the invasion of woody plant species and maturation of the existing vegetation may also become unsuitable. The establishment of their habitat as being of exceptional resource value is ecessary to minimize direct impacts to the wetlands and, perhaps more importantly, ensure that activities adjacent to the wetlands which can impact the hydrology of the wetland complex will also be regulated.

**Comments**

It has been suggested that Henslow's sparrow has similar habitat requirements to those of the sedge wren (Cistothorus platensis). Due to species habit of using both upland and wetland habitat, not all sightings of the species will lead to exceptional resource value classifications. Management may also be necessary to maintain suitable habitat conditions.

**Primary Author(s):**

Larry Torok, Land Use Regulation

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**Name: Short-eared owl (*Asio flammeus*)**

**Status: State endangered.**

**New Jersey Distribution:**

Historically, short-eared owls nested in salt and brackish water marshes in the coastal zone from the Meadowlands to Cape May. Recent studies have identified the species as an unconfirmed or infrequent breeder in Ocean, Cape May, Atlantic, Sussex and Salem counties (USDA and NJDEP 1980; D. Hughes in Tate 1992). Last suggested nesting attempt documented was in Supawna Meadows, Salem County in 1989 (Walsh et al. 1999), Occurs more widely as a winter resident in the state.

**Habitat:**

Short-eared owls occur in New Jersey during the breeding season and also as a winter resident. Habitat types frequently mentioned as suitable include fresh and saltwater marshes, bogs, prairies, grassy plains, and old fields (Bull 1964; Clark 1975; Holt and Melvin 1986). Nests are usually located in upland areas, frequently adjacent to wetlands (Clark 1975; Tate and Melvin 1988; Combs and Melvin 1989). Surrounding habitat was generally dominated by low dense shrub cover such as bayberry (*Myrica pennsylvanica*), black huckleberry (*Gaylussacia baccata*) and dense grasses (Tate and Melvin 1987, 1988).

Habitat structurally similar to nesting habitat is used by the short-eared owl for foraging, resting, and roosting during the breeding season and winter. However, in addition to the structure of the habitat, suitable habitat is described as sizeable (see discussion under home range) and also should feature "abundant" populations of prey (Craighead and Craighead 1956; Clark 1975; Johnsgard 1988). Roosting has been documented from abandoned dumps, quarries, gravel pits, storage yards, stump piles, small evergreen groves, bayberry thickets, dunes, and open abandoned cellars (Clark 1975; Bosakowski 1986). Wintering short-eared owls in Hunterdon County have been identified using agricultural land featuring wet mowed fields segmented by shrubby hedge rows and roadways (L. Torok pers. comm.)

**Home Range/Movements:**

A summary of home range/territory data for the short-eared owl is provided in Table One. Based on these data, Tate (1992) suggested that areas a minimum of 50 ha (125 ac) of low, open grasslands or similar habitat which featured abundant rodent populations warranted protection. It must be noted that the data provided above is based on diurnal activity and it has been suggested that nocturnal foraging may be more extensive (K.P. Combs in Tate 1992).

**Survey Methodologies:**

Combs and Griffin (1990) surveyed for short-eared owls by driving survey routes within suitable habitats during the early morning and late afternoon. Tate (1992) recommends surveying for the species in early mornings, at dawn and just after, and late afternoons, 2-3 hours before sunset.

**Regulatory Guidelines:**

1. Area of Documentation: Wetlands featuring a documented sighting of the species. Habitats used for breeding and wintering owls will be considered under this standard. While the extent of wetland considered "documented" will be established on a case by case basis, Tate (1992) recommended minimum areas of 50 ha. (125 ac) be considered.

2. Suitable habitat: The following characteristics will be evaluated when establishing the suitability of wetland habitats for the short-eared owl.

a. Vegetative characteristics. Favored vegetation structure is open field/successional type habitats featuring variable stands of shrub cover (see discussion above).

b. Evidence of small mammal populations. As indicated above, "abundant" populations of small mammals are favored in short-eared owl habitats. The current lack of details on densities within documented territories lend evaluation of this characteristic to a case by case analysis.

c. Extent of available habitat. See home range discussion above.

**Comments:**

Short-eared owls share similar habitat requirements and often co-occur with the northern harrier (*Circus cyaneus*) in breeding and wintering habitats.

**Rationale:**

Due to the precarious status of the short-eared owl in New Jersey, the protection of current or historic breeding sites which remain suitable is paramount in maintaining the species as a component of our natural resource base. The protection of wintering habitats is required in that winter habitats often share similar characteristics with breeding and have been documented to become breeding grounds (Clark 1975). The variable use of upland and wetland areas and the lack of more specific quantification of the habitat requirements of this species make establishing firm guidelines on designating exceptional resource value wetlands based on sightings of short-eared owls a difficult task. As a result, the Department will determine the extent of exceptional resource value wetlands based on sightings of this species on a case by case basis.

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**Name: Red-shouldered hawk (*Buteo linneatus*)**

**Status: State endangered (breeding); state threatened (winter and migration).**

**New Jersey Distribution:**

Red-shouldered hawks may occur throughout the state. However, two areas appear to feature a majority of the breeding population. In south Jersey, red-shouldered hawks primarily occur in swamps along the Delaware Bay in Cape May and Cumberland Counties in limited numbers. In north Jersey, the species is concentrated in the Pequannock Watershed in Passaic County. Other known locales include the Kittatinny mountains in Sussex and Warren Counties, the Great Swamp in Morris County, and the Ramapo Mountains in Bergen County. Scattered records occur from additional locales. Red-shouldered hawks were listed as possible, probable, or confirmed in 111 survey blocks by the New Jersey breeding bird atlas (Walsh et al. 1999)

**Suitable Habitat:**

The breeding habitat used by red-shouldered hawks varies from lowland hardwood, mixed, and conifer forests to upland mixed and conifer forests (Henny et al. 1973; Bednarz and Dinsmore 1981; Titus and Mosher 1981; Falk 1990; Crocoll and Parker 1991). Surrounding habitats were almost always characterized by nearby waterbodies (e.g. swamps, rivers, ponds) and tracts of forest (Kimmel and Fredrickson 1981; Morris and Lemon 1983).

Nest sites in Massachusetts were located in wet deciduous woods with mature yellow (*Betula lutea*) and black (*B. lenta*) birches being the favored nest tree species (Portnoy and Dodge 1979). In Maryland, Titus and Mosher (1981) identified red-shouldered hawk nests in white oak (*Quercus alba*), red oak (*Quercus rubra*), tulip (*Liriodendron tulipifera*), and American beech (*Fagus grandifolia*). Falk (1990) reported a strong association between red-shouldered hawk nest sites and beech, red maple (*Acer rubrum*), and hemlock (*Tsuga canadensis*) densities in Connecticut. A review of the literature on red-shouldered hawk nest sites conducted by Bednarz and Dinsmore (1981) revealed use of 40 different tree species.

Several studies have further analyzed the characteristics of the habitat surrounding red-shouldered hawk nest sites. In Arkansas, Preston et al (1989) evaluated the habitat surrounding nests located in forest communities of oak-hickory, elm-ash-cottonwood, and oak-gum-cypress. All nest sites were determined to be located closer to water, to feature larger trees and a more dense understory than random sites. Titus and Mosher (1981) found red-shoulder hawk nest sites in Maryland featured denser understories, greater basal areas, larger overstory trees, and occurred lower in the canopy and closer to water than nests of four other raptor species. In northern New Jersey, Bosakowski et al. (1991) found nests were located in areas characterized by significantly greater amounts of wetlands, coniferous forest, and mixed forest, and significantly less suburban area and deciduous forest. In a futher analysis of occupied and un-occuipied sites, Bosakowski et al. (1992) found a higher percentage of wetlands around occupied nest sites than was found in unused sites. For southern New Jersey, Sutton and Sutton (1985) found Cumberland County nests to occur in old growth, hardwood swamp forest, and Cape May County nests in younger aged wet woods. Vegetative communities associated with 1991-1992

surveys of south Jersey were typified by Atlantic white cedar (*Chamaecyparis thyoides*), red maple, black tupelo (*Nyssa sylvatica*), sassafrass (*Sassafras albidum*) and sweetbay magnolia (*Magnolia virginiana*) with surrounding habitats of oak-pine forest and agricultural field (Dowdell and Sutton 1992).

Senchak (1991) studied breeding and post-breeding habitat use by red-shouldered hawks on the Patuxent Wildlife Research Center in Maryland. Her data indicated that water sources (river and ponds) were the most frequently selected habitat type use by the species. Other favored habitat types used included bottomland forest, river swamp, terrace/bluff forest, and residential/commercial areas. Occasional or avoided habitats consisted of seepage swamp, pine forest, pine/oak forest, upland oak forest, and power lines. Tree species occurring in favored habitat included beech, tulip-popular, sweetgum (*Liquidambar styraciflua*), river birch (*Betula nigra*), and red maple (*Acer rubrum*).

When venturing away from nests to forage or during the non-breeding seasons, red-shouldered hawks tend to broaden the habitats used. Various authors have indicated the use of primarily non-forested areas within their home ranges for foraging (Bent 1937; Protnoy 1974 in Bednarz and Dinsmore 1981; Bednarz and Dinsmore 1981). During the winter, the species has been observed making use of open habitats (Craighead and Craighead 1956; Bohall and Collopy 1984). In Maryland, wintering hawks were often observed foraging in edge habitats between fields and forest (M.R. Fuller in Hands et al. 1989).

Special Considerations: Great horned owls (Bubo virginianus) are known predators on red-shouldered hawks, having been documented to have caused several nest failures during Department funded surveys (Bosakowski et al. 1991; Bosakowski and Smith 1992; Dowdel and Sutton 1992). Red-tailed hawks may out compete and drive out red-shouldered hawks from their territories (Bent 1937; Craighead and Craighead 1956). Levels of human disturbance may also have adverse impacts on the use of a particular habitat by this species. Factors such as off-road vehicle use, logging, and hikers have been identified as affecting red-shouldered hawk nesting success (Bosakowski et al. 1991; Speiser et al. 1999; McKay et al. 2001). Conversely, red-shouldered hawks in California have shown success in nesting in urbanized environments (Bloom et al. 1993)

**Survey Methodologies:**

Bosakowski et al. (1991) surveyed for breeding red-shouldered hawks in New Jersey from March through June. Tape recorded vocalizations of red-shouldered hawks and red-tailed hawks (*Buteo jamacansis*) were used to elicit responses from nearby hawks. The tape consisted of a initial period of silence (to allow for researchers to seek cover) followed by 3 minutes of red-shouldered hawk calls, 3 minutes of silence and 3 minutes of red-tailed hawk calls. Dowdell and Sutton (1992) surveyed regions of south Jersey in the following fashion. Routes consisting of 10-13 survey points were run nine times during March through June. Each point was surveyed a maximum of nine times. Five minutes of passive listening followed by a four minute period of red-shouldered hawk calls and a five minutes listening period were conducted during each survey session.

**Regulatory guidelines:**

1. Area of documentation: Contiguous forest parcels associated with known breeding locales. See forest mapping discussion in Section 1.

2. Suitable habitat: See discussion provided above for details on plant species composition, vegetative community structural features, and surrounding land uses. The evaluation of each wetland will take into account the following characteristics:

a. Locational factors: proximity to residential, industrial, or commercial development, intensity of development, various human disturbance factors (see habitat discussion), agricultural lands, and forest block size and continuity.

b. Vegetative factors: forest age, canopy height and closure, forest species composition, understory height, stem density, and species composition.

**Rationale**

Red-shouldered hawks are an area dependent species and evidence suggests that sizeable tracts of mature forest (in excess of 400 ha/1000 ac) are required for successful reproduction. In addition the species is extremely sensitive to disturbance, predation, and competition during the breeding season. The identification and protection of suitable habitats, in particular breeding habitat, within the likely home range of the species offers the best protection strategy for ensuring the continued existence of the red-shouldered hawk within currently occupied areas. The success of this strategy is contingent upon the size and configuration of wetland habitats in relation to the eventual degree of upland development within each particular red-shouldered hawk home range.

**Primary Author(s)**
Larry Torok, Land Use Regulation Program.

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**Name: Northern Harrier (*Circus cyaneus*)**

Status: State endangered (breeding).

**New Jersey Distribution:**

Principally a breeder in tidal marshes along the Delaware Bay and Atlantic coast. Inland reports of harriers observed during the breeding season occur from various counties (D. Hughes in Serrentino 1992), but documented nesting is rare. Also known from marshes associated with the Hackensack Meadowlands and Raritan River. New Jersey breeding bird atlas surveys yielded breeding records from known coastal locales, the Hackensack Meadowlands, and Somerset county (Walsh et al 1999).

**Habitat:**

Northern harriers are primarily a species of the open country; occurring in such habitats as farm fields, salt and freshwater marshes, swamps, bogs, and wet meadows (Hall 1983; Laughlin and Kibbe 1985; Serrentino 1989). While harriers will use grasslands and agricultural areas for nesting and foraging during the winter and summer, Bildstein (1988) suggested that freshwater wetlands were the preferred breeding habitat. New Jersey's breeding harrier population occurs predominately in tidally influenced marshes.

Species associations identified within freshwater breeding areas have included meadowsweet (*Spiraea latifolia*) and red-osier dogwood (*Cornus stolonifera*) in New Hampshire, sedges (*Carex* spp.), bulrushes (*Scirpus* spp.), goldenrod (*Solidago* spp.), meadowsweet, and willow (*Salix* spp.) in Wisconsin and wet hayfields dominated by reed canary grass (*Phalaris arundinacea*) in Vermont (Serrentino 1987; Hamerstrom and Kopeny 1981; Laughlin and Kibbe 1985).

Coastal breeding habitats have featured northern bayberry (*Myrica pensylvanica*), black huckleberry (*Gaylussacia baccata*) and wild rose (*Rosa* spp.) in Massachusetts; common reed (*Phragmites australis*), salt hay grass (*Spartina patens*), and smooth cordgrass (*S. alterniflora*) in New Jersey; and common reed and poison ivy (*Toxicodendron radicans*) in New York (Holt and Melvin 1986; Dunne 1984; England 1989). Nests are commonly located on the ground in stands of dense vegetation (Bent 1937; Hecht 1951; Serrentino 1987). Other nest sites used include sedge tussocks, willow clumps, or over water, built up on sticks (DeGraaf and Rudis 1986).

Harriers will use habitats similar to the breeding habitats for hunting and roosting during the summer and winter (Bosakowski 1983; Root 1988). In Arkansas, Preston (1990) reported harriers avoided foraging over areas of dense vegetation and used wet fields dominated by bulrushes and smartweeds (*Polygonum* spp.) to a greater extent than expected. Roost sites may feature large numbers (60+) of harriers as well as short-eared owls (Asio flammeus) (Serrentino 1992).

**Survey methodologies**:

Dunne (1986) conducted harrier surveys in south Jersey in the following manner. Suitable habitats were surveyed a minimum of three times between April 9 and July 15. Criteria used to confirm nesting were:

a. Prey exchange between a male and female;

b. Male dropping prey to a suspected nest; and/or

c. Male behaving territorially to an intruder into the vicinity of a suspected nesting site.

Sightings of a pair or an individual male during the breeding season without any of the other criteria was not considered to constitute a confirmed nesting.

**Regulatory Guidelines:**

1. Area of Documentation: Refer to Appendix 1, Section I above.

2. Suitable habitat: The following characteristics will be evaluated when establishing the suitability of wetland habitats for the northern harrier.

a. Vegetative characteristics. Favored vegetation is open field, marsh and early successional type habitats featuring variable stands of shrub cover (see discussion above).

b. Abundance of small mammal populations. As indicated above, population densities of small mammals influence the suitability of and number of pairs of harriers a habitat can support. The current lack of details on densities within documented territories lend evaluation of this characteristic to a case by case basis.

c. Extent and continuity of available habitat. See home range discussion above.

**Special Considerations:**

Harriers are known to roost communally in the winter. The Department will review winter roost sites on a case by case basis to determine if any wetlands associated with them would warrant an exceptional resource value classification.

**Comments:**

Currently, the Department does not have documentation of confirmed harrier breeding in freshwater wetlands. Fringe wetlands along Delaware Bay from Alloways Creek in Salem County through Cape May and along Atlantic coast from the Tuckahoe-Great Egg Harbor marshes through the Forsythe NWR may provide suitable foraging habitat. Northern harriers share similar habitat requirements and often co-occur with the short-eared owl (Asio flammeus) in breeding and wintering habitats.

**Rationale**

Northern harriers are currently only identified nesting in brackish marshes along the Delaware Bay shore and in Atlantic coast areas. The protection of the freshwater wetland fringe and application of transition areas on these sites serves to maintain suitable expanses of foraging areas and habitat for prey.

Despite not currently being documented from freshwater wetlands, breeding harriers occur in such habitats in nearby states. As a result, the protection of inland breeding sites, when they are identified, is instrumental in maintaining breeding populations in New Jersey. The variable use of upland and wetland areas and the lack of more specific quantification of the habitat requirements for this species make establishing firm guidelines on designating exceptional resource value wetlands based on sightings of this species a difficult task. As a result, the Department will determine the extent of exceptional resource value wetlands based on sightings of this species on a case by case basis.

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Walsh, J., V. Elia, R. Kane, and T. Halliwell. 1999. Northern harrier (*Circus cyaneus*) pgs. 173-175 in Birds of New Jersey. New Jersey Audubon Society. 704 pp.

**Name: Sedge Wren (*Cistothorus platensis*)**

**Status**: **State endangered**.

**New Jersey Distribution**

State breeding range has been suggested as the coastal strip from Burlington County through Cape May and north to the Hackensack Meadowlands. However, most records come from the along the Delaware bayshore in Cumberland and Cape May Counties and the large marsh complexes of northeastern Jersey. Isolated records reported from Burlington, Salem, and Sussex Counties. New Jersey breeding bird atlas survey efforts found breeding activity in Sussex, Somerset, Salem and Cumberland counties (Walsh et al. 1999)

**Habitat**

Sedge wrens occur in early successional sedge (*Carex* spp.) meadows, shallow sedge marshes with scattered shrubs and little to no open water, and coastal brackish marshes featuring Spartina patens or switchgrass (*Panicum virgatum*) with scattered low shrubs and herbs (Stewert and Robbins 1958; Crawford 1977; Leck 1984; Anderle and Carroll 1988). The species is highly sensitive to site hydrology, abandoning sites becoming "too wet" or "too dry" and/or those which become overgrown with shrubs (Gibbs and Melvin 1992).

Various studies throughout the country have identified several characteristics typical of sedge wren habitats. Emergent wetland habitats featuring sedges are frequently identified (Palmer 1949; Stewert and Robbins 1958; Picman and Picman 1980; Burns 1982; Manci and Rusch 1988). Other species singled out in sedge wren locales include bulrushes (*Scirpus* spp.), white-top (*Scolochloa festucacea*), and reed canary grass (*Phalaris arundinacea*) (Burns 1982; Picman and Picman 1980; Crawford 1977). Niemi (1985) characterized sedge wren habitats in Minnesota to feature 303 sedge stem/sq. meter, 16 forb stems/ sq. meter, 50 shrub stems/sq. meter, and a predominant vegetation height of 1.1 meters. In Wisconsin, Sample (1989) found sedge wrens to occupy ares with an average of 2% woody cover, 82% herbaceous cover, 17% litter cover, 0.2% bare ground, 7% standing residual cover, and 1% water cover. In Nebraska, Lingle and Bedell (1989) reported sedge wrens to nest near wetland borders where the predominant vegetation consisted of water sedge (*Carex aquatilis*), common ragweed (*Ambrosia artemisiifolia*), and river bulrush (*Schoenoplectus fluviatilis*). Manci and Rusch (1988) reported that sedge wrens avoided areas of deepwater cattail (*Typha* spp.), shallow-water cattail, and river bulrush. Sparce shrub growth has also been commonly identified as a component of successful sedge wren breeding areas (Palmer 1949; Tordoff and Young 1951; Niemi and Hanowski 1984).

Little information is available on the use of wetland habitats by over-wintering sedge wrens. Brackish and freshwater emergent meadows and marshes have been identified (Howell 1932).

**Survey Methodologies:**

No specific techniques have been developed to survey for sedge wrens. Aural listening in suitable habitats and/or use of tape calls to elicit responses from territorial birds has been

suggested (Manci and Rusch 1988). Since the species may not establish a breeding territory until late June or July, survey efforts should be conducted from April through these months. Sedge wrens will also sing during migration (Cromartie 1982).

**Regulatory Guidelines:**

1. Area of documentation: Due to the species subtle habitat requirements, the establishment of the extent of wetlands to be evaluated will be done on a case by case basis. Gibbs and Melvin (1992) suggested a minimum area of 5 ha (12.5 ac.) of suitable habitat be considered to minimize area related effects of predation on grassland birds.

2. Suitable habitat: Wetlands suitable for use by sedge wrens can be characterized as:

   a. marshes, meadows, or wet fields which are not saturated, flooded or ponded;

   b. emergent areas featuring a predominance of sedges, rushes, and/or grasses; and

   c. a sparce shrub community of 1-2 meters (3.28-6.5 ft.) in height.

**Rationale**

Sedge wrens are highly dependent on a sensitive wetland hydrologic regime. Habitats which become too wet or too dry are abandoned. Sedge wren habitat is also subject to impacts from vegetational succession. The establishment of their habitat as being of exceptional resource value is necessary to minimize direct impacts to the wetlands and, perhaps more importantly, ensure that activities adjacent to the wetlands which can impact the hydrology of the wetland complex will also be regulated.

**Comments**

Sedge wrens are apparently not site tenacious, often abandoning sites after 1-3 years. However, such habitat instability may reflect variations in local or annual weather conditions rather than the absolute unsuitableness of a particular habitat. Management may also be necessary to maintain suitable habitat conditions.

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**Name: Bald Eagle (*Haliaeetus leucocephalus*)**

**Status: Federally threatened, state endangered.**

**New Jersey Distribution**:

Research has documented a minimum of 22 bald eagle nests in New Jersey prior to 1960 (Niles 1984, Holstrom 1986). Through the summer of 2003, 35 pairs of eagles showed active breeding behavior with another 5 pairs being watched for potential nesting (Smith et al 2003). Breeding pairs occurred in Atlantic, Burlington, Camden, Cape May, Cumberland, Gloucester, Hunterdon, Monmouth, Salem, and Warren Counties. Significant wintering areas occur along the Delaware Bay, Maurice River, Egg Harbor River, Wading River, and the Delaware River from Belvidere north to the New York State border.

**Habitat:**

Bald eagles occur as two populations in New Jersey. The main breeding population exists in forests and marshes within the drainage system of Delaware Bay and along the Delaware River. The state's winter population consists of overwintering breeders and transient birds from breeding sites to the north. This population is largely concentrated along tributary waters of the Delaware Bay and the Delaware River.

Breeding habitat: Preferred nesting habitat generally consists of large nest trees in discontinuous forest stands near open water feeding grounds (Jaffee 1980; Evans 1982; Andrew and Mosher 1982). In their research of bald eagle habitat along the Chesapeake Bay in Maryland, Andrew and Mosher (1982) selected their study area boundaries based on the assumption that suitable breeding habitat consisted of forested areas with trees featuring dbhs of at least 30 cm (12 in) which occurred within 3 kms (1.8 mi) of open water. Cline (1993) noted for Virginia that eagle nests were often located in open mature forest stands at least 8 ha. (20 ac.) in size, within 1 km (0.6 mi) of both wetlands and waters.

Trees used for nesting by bald eagles may be either hardwood or softwood and are generally characterized by their large size and height (Smith 1936; Hansen 1987). The seventy nest sites studies by Andrew and Mosher (1982) included 10 different species averaging 62 cm (24.8 in) in diameter and 23 m (75 ft) in height. Similar findings were made in Alaska and Virginia (Robards and Hodges 1974; Jaffee 1980). In New Jersey, most nest trees are taller than surrounding forest habitat (L. Niles pers. comm.). Tree species used for nesting include sycamore (*Platanus occidentalis*), hickory (*Carya ovata*) and loblolly pine (*Pinus taeda*)(Niles et al. 1991).

Another important characteristic of bald eagle nesting habitat are openings in the canopy of the nest tree and the forest around it. In Florida, Wood and Collopy (1989) reported that nest trees were not significantly taller than the surrounding forest but appeared to be generally larger and featured stem densities which permitted access through the crown. Jaffee (1980) suggested that the form of the tree was more important to its suitability for nesting than the species. In regard to

the closure of the canopy in surrounding forests, this feature has been documented to vary from 61% in Maryland (Mosher and Andrew 1981) to < 20 % in California (Lehman et al. 1980). It has been suggested that this discontinuity of canopy is necessary to allow eagles to maneuver around their nests (Grubb 1976; Todd 1979; Andrew and Mosher 1982).

Nest trees are commonly found in proximity to water. Mean distances from water have varied from 36 m (118 ft) in Alaska to over 1.2 km (0.7 mi) in Oregon (Robards and Hodges 1977; Anthony and Isaacs 1981). Additional work in Oregon determined that 84% of eagle nests occurred within 1. 6 km (1 mi) of water with a maximum distance of 7.4 km (4.4 mi) (Anthony and Isaac 1989). In Maryland, over 90% of the eagle nests occurred within 1.5 km (0.9 mi) of water (Taylor and Therres 1981).

Resting and feeding habitat: The primary prey item for eagles is fish (Retfalvi 1970; Dunstan and Harper 1975; DeGraaf et al. 1980; Todd et al. 1982). However, eagles will also take various species of birds, reptiles, mammals, and invertebrates in direct relation to their availability (Cline and Clark 1981; Frenzel 1984).

Given these feeding habits, preferred foraging habitat for bald eagles are rivers, lakes, and estuaries (DeGraaf et al. 1980). Large water bodies are favored over small ones with little use being made of smaller streams and ponds (Leighton et al 1979). Based on his review of existing documentation, Peterson (1986) concluded that waterbodies should be a minimum of 8 ha (12 ac) in size with lakes featuring a surface area > than 10 sq. km (3.8 sq. mi) being considered of optimum size. For Maine, Livingston et al. (1990) suggested that waterbodies a minimum of 30 ha (75 ac) in size were necessary for eagle nesting.

Wintering habitat: In general, wintering bald eagles will tend to concentrate in forested areas often adjacent to open, unfrozen, water bodies (Evans 1982). Habitat components important to wintering bald eagles include the availability of prey, perch sites and roosting areas.

Diets of wintering bald eagles differ from breeding eagles primarily in the diversity of food taken. As mentioned above, eagles principally feed upon fish during the breeding season. During the winter, studies have indicated that eagles feed upon such prey items as sick and crippled waterfowl (Southern 1964; Griffin et al. 1982; Keister et al 1987) small mammals (Frenzel and Anthony 1989), deer carcasses (A. Peterson, N.Y. DEC, Albany; unpubl. in Peterson 1986), road kills (Retfalvi 1970; Platt 1976) as well as fish (Knight and Knight 1983) in direct relation to their availability. Eagles at an inland roost site studied by Harper et al. (1988) in Illinois fed primarily on carrion and small birds.

The characteristics and availability of suitable perch sites is also of significance to wintering bald eagles. Steenof et al. (1980) analyzed the characteristics of bald eagle perch sites within a floodplain in South Dakota. Trees were the favored perch sites for eagles in this study, though they were also observed on the ground, cliff faces and partially submerged logs. Ninety-four percent of the perched eagles were observed within 30 meters (98.4 ft.) of the riverbank. Favored perch sites generally consisted of tall (mean 21.1 m/69 ft), large (mean 42.3 cm/17 in) trees featuring stout, horizontal branches with at least one side facing an open area. The authors

also noted that the proximity to a quality foraging site may be more important than stand characteristics in perch site selection.

Similar habitat use was observed by Stalmaster and Newman (1979) in northwestern Washington. All eagles observed were perched within 50 meters (164 ft.) of the riverbank, predominantly in large snags or black cottonwoods (*Populus trichocarpa*) with little preference being shown for evergreen species. Other characteristics identified were similar to those mentioned above. Chester et al. (1990) reported season variation in the use of perch sites in North Carolina. Pines were used to a greater extent than hardwoods during the season when leaves were present, to a lesser extent when leaves were absent. Bowerman et al. (1994) established an age variation in perch site selection in Michigan with adult birds using deciduous and evergreen trees for perching equally, while juvenile birds favored deciduous trees. This study also indicated that levels of disturbance affect perch site selection with birds favoring taller trees near residences and conifers over deciduous trees in areas of human disturbance.

Bald eagle winter roost habitat tends to feature structural characteristics similar to those identified for breeding and perch habitat. For one, roost sites are commonly located in proximity to suitable open water feeding areas. Buehler et al. (1991a) reported 95% of the roost sites identified along the Chesapeake Bay to occur within 790 meters (2591 ft) of water. Hansen et al. (1980) reported roost sites distances from feeding sites to vary from 0.25 km (0.15 mi) to 2.4 km (1.4 mi). Stalmaster and Gessaman (1984) concluded that the maximum distance metabolically favorable between a roost site and suitable feeding habitat is 3.9 km (2.3 mi).

The size of forest stands used for roosting is highly variable. In Virginia, Cline (1993) found communal roosts to be 0.39-1 ha (1-2.5 ac) in size and occurred within much larger forest stands [aver. 1543 ha (3800 ac)]. Sites evaluated by Keister and Anthony (1983) varied from 8 to 254 ha (12 to 575 ac.). Other variables examined in this studied included trees per hectare (25.6-79.2), dbh [50.4-61.3 cm (20.2-24.5 in)] and height [24.6-27.2 m (80.7-90.5 ft). In contrast, inland roost sites in Illinois occurred 13-20 km (7.8-12 mi) from suitable feeding habitats along the Mississippi (Harper et al. 1988). All roost sites appear to be selected in areas protected from the prevailing winds (Steenof 1978; Keister et al. 1985). Keister et al (1987) determined that eagles shifted their roost locations in response to stressful weather conditions and prey populations. They also determined that adult eagles tended to roost in areas further from prey than sub-adults.

Roost trees may be hardwood or softwood. Stalmaster and Gessaman (1984) suggested that old growth conifer stands where generally favored over deciduous stands with some variation occurring based on proximity to feeding habitat and severity of weather. In Maryland, Buehler et al (1991a) found roost habitat more likely to feature hardwoods, high canopies, and snags than random sites. In northwestern Washington, stands of predominantly Douglas fir (*Pseudotsuga menziesii*) and western red cedar (*Thuja plicata*) were favored (Stalmaster and Newman 1979). Keister and Anthony (1983) reported roost sites to be dominated by ponderosa pine (*Pinus ponderosa*) and other mixed conifers in the Klamath basin in Oregon and California. Roost sites in North Carolina featured relatively open crowns with large branches and were dominated by sizable, dead hardwoods and loblolly pines (Chester et al. 1990). Roost trees were generally taller than the surrounding canopy or associated with open areas (Stalmaster and Newman 1979).

Management recommendations for maintaining suitable roosting habitat have included actions which preserve old growth stands and maximize large open structure and dead or spike-topped trees (Keister and Anthony 1983).

**Survey methodologies**

No systematic methodology has been established to survey for bald eagles. Due to the conspicuous nature of the species and its nest, most surveys consist of searching suitable habitat on the ground and from the air for evidence of the species (Steenhof et al 1980; Andrew and Mosher 1982). In New Jersey, winter surveys are conducted by all-day visual watches within suitable (e.g. open water, mature forest stands) habitats.

**Regulatory Guidelines:**

1. Area of documentation: Refer to discussions in Appendix 1 for breeding habitat and Section I above or Appendix 1 for eagle foraging habitat .

2. Suitable habitat: Due to the necessity to minimize various forms of disturbance in the vicinity of a nest site, the Department will apply the following criteria in accessing the suitability of habitat for breeding eagles.

a. **Breeding habitat**: All vegetated wetlands within and contiguous with a 1 km (0.6 mi) radius of the nest will be considered to be a suitable component of eagle habitat. Tracts of forested wetland contiguous with the nest location within this radius will be considered to be suitable breeding habitat. Wet farm fields, other "disturbed" wetland habitats and wetlands under 0.4 ha (1 ac) in size will be judged on a case by case basis

b. **Suitable feeding/resting habitat**: sites will consist of:

1. Forested wetlands featuring dead and/or live trees with a dbh greater than 12 cm (8 in) contiguous with a suitable water body [e.g. > 8 ha (20 ac.)] featuring the prey items discussed above;
2. Forested wetlands which are a component of a contiguous forest stand within 300 m (984 ft) of a suitable waterbody (e.g. > 8 ha) featuring the prey items discussed above;
3. Scrub-shrub or emergent freshwater wetlands will be considered on a case by case basis.

**Special consideration**

Many additional factors may affect the suitability of a particular habitat for use by eagles. These include the likelihood, timing and duration of human disturbance and the type, configuation, and density of surrounding development. Within the entire area of documentation and/or as they may relate to an individual wetland, these factors will be evaluated along with the structural characteristics of that wetland when establishing its suitability for bald eagle use. Densities of >

1 house per ha and human disturbance within 500 m (1640 ft) of the shoreline of the Chesapeake Bay affected the presence of nesting eagles (Buehler et al 1991b). It should be noted that variation occurs in regard to the tolerance of bald eagles to disturbance.

**Rationale**

The selection of breeding sites for bald eagles is largely a function of the availability of nest trees or a forest stand suitable for nesting and sufficiently isolated from constant disturbance to allow for successful reproduction. In order to maintain the suitability of breeding sites, direct protection of the habitat is necessary as well as indirect protection by keeping various types of disturbance distant from the nest. The extension of an exceptional resource value classification to wetlands associated with a "zone of disturbance" around a breeding location is necessary to maintain the suitability of a habitat for breeding by bald eagles by keeping sources of disturbance away from the breeding site. Such protection also addresses the needs of fledged young and their habitat use near the nest prior to dispersing.

In regard to the designation of resting and feeding sites for breeding and wintering eagles, various setbacks have been suggested to maintain the suitability of feeding sites. Documentation has suggested that buffers of between 100 m (328 ft) to 500 m (1640 ft) may be necessary adjacent to breeding or wintering eagle perching and feeding sites to maintain their suitability (Stalmaster and Newman 1978; Knight and Knight 1984; Cline 1985; Cline 1993). In designing the bald eagle foraging model the Department incorporated 90 m (300ft) setbacks of off suitable open water foraging habitat and contiguous marsh habitats. While in some cases, these recommendations exceed the setbacks adjacent to wetlands provided by the Freshwater Wetlands Protection Act, they do provide criteria where the establishment of transition areas will assist in maintaining the suitability of habitat for use by the species. In addition, the protection of winter habitat benefits the state's breeding population because all of New Jersey's breeders remain in the state during the winter.

**Primary Author(s)**

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**Name: Pied-billed Grebe (*Podilymbus podiceps*)**

**Status: State endangered (breeding population).**

**New Jersey Distribution**:

All of New Jersey occurs within the species' breeding range. Instate records are localized and wide-spread. Breeding sites include Mannington Meadows (Salem), Trenton Marsh (Mercer), Whitesbog (Burlington), and Kearny Marsh (Hudson). The New Jersey breeding bird survey confirmed grebes in scattered locales in Sussex, Burlington, Salem, Cape May, Monmouth, Middlesex, and Hudson Counties (Walsh et al. 1999)

**Habitat**:

Pied-billed grebes occur primarily in freshwater marshes featuring an interspersion of open water and emergent vegetation habitats. They may also use sluggish streams which feature overhanging vegetation. A discussion of the habitat identified in various studies follows.

Glover (1953) compiled data on grebe nesting areas in northwestern Iowa. Sites were characterized as emergent/open water complexes. Nest site vegetation commonly consisted of fairly dense stands of pale spike rush (*Eleocharis macrostachya*), hard-stemmed bulrush (*Scirpus acutus*), and soft-stemmed bulrush (*Scirpus validus*). Nests were generally located in waters 27-100 cm. (11-40 inches) deep and within 18 meters (60 ft.) of open water habitats. Successful nests were an average of 97 meters (305 ft.) from the shore.

In Louisiana, Chabreck (1963) reported the habitat conditions used by nesting pied-billed grebes in a brackish marsh. The 80 ha. (200 ac.) impoundment was characterized by open water areas featuring submerged growths of wigeongrass (*Ruppia maritima*). Emergent areas (about 25%) were dominated by wiregrass (*Spartina patens*). Water depths averaged 45 cms (18 inches) in open water areas and varied from 20-30 cms (8-12 inches) in the Spartina stands.

In North Dakota, Faaborg (1976) described pied-billed grebe habitat as follows. Ponds supporting breeding grebes averaged 2.2 ha. (5.5 ac.) in size with a range of 0.6 to 7 ha.(0.24-17.5 ac.). Such ponds generally featured dense stands of vegetation (usually *Typha* spp.) in conjunction with open water areas. Fifty percent of the small ponds occupied by grebes had only 20-40% open water. Of the larger (> 2 ha.) ponds featuring nesting grebes, all featured dense stands of emergent shoreline vegetation.

Prairie pothole habitats in Manitoba featured emergent vegetation composed of bulrushes, cattail, and whitetop (Scholochioa festucacea) (Sealy 1978). Nests were located in water averaging 35 cms (14 inches) in depth, and were within 6 m. (20 ft.) of the shore and 1.3 m (4 ft.) of open water. Other work conducted on prairie pothole wetlands by Nudds (1982) and Barnes and Nudds (1989) indicated a partitioning of such habitats between pied-billed grebes, horned grebes (*Podiceps auritus*), eared grebes (*P. nigricollis*) and American coots (*Fulica americana*). They concluded that pied-billed grebes occurred in wetland habitats of generally shallower water,

larger size, denser vegetation, and which featured greater "spacial heterogeneity" than habitats used by the other species.

Forbes et al. (1989) analyzed pied-billed grebe nesting habitats on a 35 ha. (87.5 ac.) impoundment in Nova Scotia, Canada. The site consisted of 65% open water and 35% emergent vegetation. Emergent areas consisted of cattail, burreed (Sparganium eurycarpum), soft-stemmed rush (*Scirpus validus*) and reed (*Phragmites australis*) in densities of 59.2%, 33.8%, 3.6% and 3.4% respectively. Nest sites occurred in areas with less emergent vegetation, greater water depths, near to open water, and were further from shore than random points. Based on these findings, the authors concluded that pied-billed grebes prefer "fragmented habitats of interspersed emergent vegetation and open water areas over denser stands of vegetation for nesting". In a similar site in South Carolina, Post and Seals (1991) established a correlation between numbers of nesting grebes and an increase in emergent vegetation (*Hydrilla verticillata*). In a study conducted in Maine, Gibbs et al. (1991) determined that wetlands used featured greater levels of aquatic-bed vegetation, ericaceous vegetation, and emergent vegetation than did unused sites.

**Survey Methodologies:**

Brown and Dinsmore (1986) visited swamps between sunrise and 1000 hours three times annually. Six minute observation periods were used at each stop with tape calls being played to elicit responses during the last 2 minutes of each period. Gibbs et al. (1991) surveyed wetlands for a variety of wetland species through repeated listening periods of 2-3 hrs begining 0.5 hrs before sunrise or 1.5 hrs prior to sunset during April-August. Gibbs and Melvin (1993) further refined the survey process using tape calls to elicit responses. Survey points were established in a density of approximately 1/5 ha (12 ac) with most survey work being done by canoe. Tapes used featured 50 seconds of male territory vocalizations followed by 10 seconds of silence. They suggested that surveys for pied-billed grebes should be conducted during the morning (4-10 A.M.) during the breeding season (mid-May to late Jun. in Maine).

**Regulatory Guidelines:**

1. Area of Documentation: Wetlands and/or wetlands complex featuring documented evidence of the occurrence of the species based on a confirmed sighting or identification by call during the breeding season (mid-April into August). Given the spacial variation of documented pied-billed grebe habitats, ranging from 0.6 ha. (1.5 ac.) to 80 ha. (100 ac.), no definitive size standards can be applied. Each wetland complex will be evaluated on a case by case basis. Gibbs and Melvin (1992) suggest that a minimum wetland size of 5 ha (12.5 ac.) be applied in the Northeast.

2. Suitable habitat: Suitable habitat for the pied-bill grebe consists of fragmented or interspersed areas of dense emergent vegetation with channels or other open water areas. Associated vegetation species include cattails, bullrushes, and phragmites.

**Rationale:**

Protection of the emergent, breeding habitat of the pied-billed grebe is required to insure the species continued existence in New Jersey. Sufficient wetland areas will need to be identified on a case by case basis to make certain that impacts are minimized to suitable breeding habitat. In general, ponded marsh areas featuring emergent vegetation interspersed with open water habitat will receive an exceptional designation. However, on larger wetland complexes or complexes featuring a mosaic of wetland habitats (e.g. Trenton Marsh), inclusion of additional wetland "buffer" areas outside of the emergent habitat may be required.

**Primary Author(s):**

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DRAFTDATE: 08/08/94 UPDATE: 06/28/02

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**Species: Long-eared Owl (*Asio otus*)**

**Status: state threatened**

**New Jersey Distribution**:

In general, long-eared owl range probably extends throughout most of New Jersey. Historical records are widely distributed. More recently, breeding acitivity was largely concentrated in Hunterdon and Sussex Counties, with other breeders likely occurring in several large north Jersey swamp complexes (e.g. Great Piece Meadows, Troy Meadows)(Bosakowski et al. 1989c). New Jersey breeding bird atlas surveys only confirmed breeding in Sussex, Morris, and Essex counties (Walsh et al. 1999). Large areas of potential breeding habitat in coastal areas of the Delaware Bay have largely gone unsurveyed. Winter populations are more widespread.

**Suitable habitat:**

As with several other species, long-eared owls may use both upland and wetland habitats. The controlling factor appears to be the structural characteristics of the habitat rather than a particular reliance on the hydrologic attibutes of wetlands.

In general, long-eared owls are associated with open field or meadow habitats interspersed with hedge rows, wood lots, conifer groves or plantations for breeding and winter roosts (Bent 1938; DeGraaf and Rudis 1986; Bosakowski et al. 1989a). Various studies throughout North America and Europe have confirmed these findings (e.g. Craig and Trost 1979; Wijnandts 1984; Marks 1986; Kren 1987).

Breeding habitat: Nesting usually occurs in dense stands of forest, either hardwood or evergreen (DeGraaf and Rudis 1986). Details for the few comprehensive studies are provided below.

Perhaps the most complete evaluation of long-eared owl nesting habitat comes from Britain (Glue 1977). An analysis of 200 records of nest sites yielded use of a variety of upland and wetland habitats. Wetland habitats identified as being used by long-eared owls included unimproved mosslands (9.5%), lowland heath (4.5%), and marshes (3.5%). It is likely that other wetland sites occurred in the forest and farmland categories which accounted for a majority of the habitats used.

Nest sites in various studies in Idaho most frequently occurred in areas characterized as sagebrush (*Artemisia tridentata*)-grass prairie interrupted by riverine systems composed of cottonwood (*Populus* spp.), willow *(Salix* spp.), black locust (*Robinia pseudoacacia*), or Russian olive (*Elaeagnus angustifolia*) stands with understories of river hawthorn (*Crataegus rivularis*) and wild rose (*Rosa* spp.) (Marks 1984; Marks 1986; Craig et al. 1988). Further analysis by Marks (1986) indicated that nests were only located in clumped vegetation, were generally in forest stands wider than 10 m (33 ft), and they were located near water or wet areas. Other habitats used by breeding long-eared owls include wet, dense coniferous woods or plantations and, too a lesser extent, deciduous or mixed forests in Ontario, Canada (Peck and James 1983 in

Johnsgard 1988) Emory oaks (*Quercus emoryii*) were heavily used in Arizona (Stophlet 1959). In Massachusetts, Bent (1938) recorded long-eared owls almost exclusively in dense evergreen stands.

In New Jersey, documented long-eared owl nests are predominately associated with agricultural areas. Haines (1942) reported a Burlington County nest to occur in a mixed forest glen featuring red cedars (*Juniperus virginiana* ) and birches (*Betula* spp.) with a ground cover of honeysuckle (*Lonicera* spp.) adjacent to a meadow. In a summary of the status of long-eared owls in New Jersey, Bosakowski et al (1989b) indicated that most recent breeding activity occurs in hedgerows and woodlots interspersed within tracts of extensive farmland in Hunterdon and Sussex County.

Abandoned crow (*Corvus* spp.) or magpie (*Pica* spp.) nests are commonly identified as the favored locale for nesting long-eared owls (Whitman 1924; Glue 1977; Marks 1986). Other structures used include hawk nests, squirrel nests, and artifical nest boxes (Stophlet 1959; Glue 1977; Johnsgard 1988). In an analysis of 198 nesting trees in Britan, the average height of long-eared owl nests was 6.7 m (22 ft) (Glue 1977). These data are consistent with other studies in Arizona, were nests were mostly between 4.6-6.1 m (15-20 ft) above ground (Stophlet 1959), and in Idaho, where nests were an average of 3.1 m (10 ft) in height(Marks 1986). Various species of hardwoods and softwoods are used for nesting (Whitman 1924; Stophlet 1959; Marti 1974; Craig et al 1988)

Roosting Habitat: Habitat used by long-eared owls for roosting is similar to habitats used for nesting. A communal summer roost in Idaho consisted of a stand of willows and birch along a small, dry stream channel (Craig et al. 1985). Getz (1961) reported winter roosting in a black spruce (*Picea mariana*) stand. *A Pennsylvania* roost featured monotypic stands of red pine (*Pinus resinosa*) and white pine (*P. strobus*), with a strip of red spruce (*Picea rubens*) between (Smith 1981). In Ohio, long-eared owls made extensive use of evergreen plantations consisting of red pine, scotch pin (*Pinus sylvestris*), white cedar (*Thuja accidentalis*) and red cedar (Randle and Austing 1952). Favored trees were rarely over 4.6 m (15 ft) in height. Surrounding habitats consisted of fallow fields, moist brushy openings, open orchard, deciduous woodlands, and scattered tree stands. Bosakowski et al (1989b) listed the following tree species, in order of preference, as typical components of long-eared owl roost habitat; Scotch pine, Austrian pine (*P. nigra*), Virginia pine (P. *virginiana*), red cedar, Norway spruce (*Picea abies*), arborvitae (*Thuja orientalis*), eastern hemlock (*Tsuga canadensis*), red pine and white pine.

Feeding Habitat: Various studies have indicated that the primary food item for the long-eared owl is voles (Microtis spp.) (Scott 1948; Getz 1961; Marti 1976; Craig et al 1985). In a study of long-eared owl food habits in Idaho, Marks (1984) found owls to prey upon five rodent species and suggested that prey size and availability are the primary determinants of diet rather than species.

Habitats used by the species for foraging are reflective of this preference. Getz (1961) found long-eared owls to feed over open field habitats because of the low amount of cover available for microtine prey. Areas less favored included bog, marsh, and several forested habitats. Low use of the wetland areas was believed a result of low prey populations and a heavy mat of grasses

and sedges. In their study in Ohio, Randle and Austing (1952) found prey populations to be indicative of habitats used for hunting. In drier, upland habitats, *Peromyscus ochragaster* was the major prey item. In brushy, moist field habitats, P. pennsylvanicus were used to a greater extent.

Other factors: Competition with and predation by Great horned owls (*Bubo virginianus*) has been suggested as a potential factor influencing the status and distribution of long-eared owls in New Jersey (Bosakowski et al. 1989a; Bosakowski et al. 1989c)

**Survey methodologies:**

No specific survey methodologies have been documented to determine the presence or absence of long-eared owls.

**Regulatory Guidelines:**

1. Area of documentation: For identified wetland breeding or winter roost sites, the Department will consider all wetlands within a one mile radius of the sighting location to be within the "area of documentation" for the long-eared owl. Documented nest or roost sites which occur in unregulated upland areas will not lead to the establishment of exceptional resource value wetlands.

2. Suitable habitat: For breeding or roosting, the Department will consider contiguous dense forest stands of either hardwood or softwood featuring documented breeding or roosting owls as suitable habitats. For feeding habitat, suitable wetland habitat should feature good small mammal populations, emergent or early successional vegetation and be a minimum of 4 ha (10 ac) in size.

**Comments:**

Unlike some of the other raptor species with large home ranges occurring in New Jersey (e.g. barred owls, red-shouldered hawks), the literature and species' habitat requirements do not appear to indicate a strong association between long-eared owls and wetland habitats. Additional information on this species status and habitat use in New Jersey is needed.

**Rationale:**

A review of the available literature for long-eared owls does not demonstrate a strong relationship between this species and wetland habitats. The Department is of the opinion that for the purposes of providing the regulatory protection of the Freshwater Wetland Protection Act, it must be concluded that the wetlands receiving an exceptional resource value classification based on their providing suitable habitat for the long-eared owl play an essential role in maintaining this species within an "area of documentation". As a result, nesting or roosting sites must be in wetlands or regulated transition area for the Department to initiate the exceptional resource value classification process and feeding habitat must be of sufficient size to be self sustaining if development occurs in adjacent unregulated uplands.

**Primary Author(s):**

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**Name: American Bittern (*Botarus lentiginosus*)**

**Status: State threatened.**

**New Jersey Distribution:**

All New Jersey occurs within the species breeding range. Instate records are localized and widespread, with a majority occurring in North Jersey. Breeding records came from Trenton Marsh (Mercer), Lincoln Park Gravel Pits (Morris), Great Swamp NWR (Morris), and Kearny Marsh (Hudson). New Jersey breeding bird atlas surveys only confirmed 4 breeding locales in Sussex, Burlington, and Salem counties during their 5-year survey period (Walsh et al. 1999).

**Habitat:**

Typically found breeding in wet areas such as marshes, swamps, and bogs with emergent vegetation. May also breed in wet meadows and has been documented to use dry meadows, pastures, and fields (Palmer 1962). Preferred herbaceous species include arum (*Peltandra* spp.), cattails (*Typh*a spp.), bullrushes (*Scirpus* spp.), wild rice (*Zizania aquatica*), and sedges (*Carex* spp.) (Bent 1929; Palmer 1962). Manci and Rusch (1988) heard American bitterns only in shallow water cattail or dry cattail habitats in a study conducted in Wisconsin.

Bittern wetlands in Missouri and Minnesota were characterized by water depths of 10 cm (4 inches) or less, and rank or dense vegetation with a mean height of 1.3 m (4.3 ft)(Frederickson and Reid 1986; Hanowski and Niemi 1986). Wetlands in Maine were dominated by emergent (e.g. cattails and sedges) and aquatic vegetation, with a high degree of cover/water interspersion (Gibbs and Melvin 1990; Gibbs et al. 1991). Lake sites in Quebec featured patches of floating vegetation, emergent shoreline vegetation and good amphibian populations (DesGranges and Houde 1989).

Wetland nesting sites tended to be 5-20 cm (2-8 inches) above the water (Bent 1926; Middleton 1949). Azure (1998) characterized Minnesota nest sites as being dominated by cattail, common reed (*Phragmites asutralis*), and sedges with an average water depth at nests of 31 cm (12 inches). In studies conducted in Minnesota and North Dakota, Brininger (1996) found bittern nests on floating wetlands dominatedby cattail, hardstem bullrush (*Schoenoplectus acutus*), sedge, common reed, and whitetop (*Cardaria pubescens*) with an average vegetation height of about 126 cm (51 inces). Upland nesting sites in North and South Dakota occurred primarily in vegetation > than 58 cm (23 inches) in height where the nest was concealed on the sides and top (Duebbert and Lokemoen 1977). Svedarsky (1992) described upland nest sites in Minnesota to consist of tall (> 60 cm), dense (44 cm mean 100% vertical visual obstruction) vegetation consisting of quackgrass (*Agropyron repens*)/redtop (*Agrostis stolonifera*) switchgrass (*Panicum virgatum*), timothy (*Phleum pratense*)/reed canary grass (*Phalaris arundinacea*), sweet clover (*Melilotus* spp.)/smooth brome (*Bromus inermis*) and big bluestem (*Andropogon gerardii*).

American bitterns have also been reported as using coastal salt or brackish marshes for breeding (Bent 1929). Other authors have indicated that the incidence of breeding in coastal areas is low,

with use in these areas being higher during migration and the winter season (Bull 1964; Torok 1987). The species is reported to abandon marshes when exposed to low levels of disturbance (DeGraaf and Rudis 1986).

**Survey Methodologies:**

Brown and Dinsmore (1986) visited swamps between sunrise and 1000 hours three times annually. Six minute observation periods were used at each stop with tape calls being played to elicit responses during the last 2 minutes of each period. Gibbs et al. (1991) surveyed wetlands for a variety of wetland species through repeated listening periods of 2-3 hrs begining 0.5 hrs before sunrise or 1.5 hrs prior to sunset during April-August. Gibbs and Melvin (1993) further refined the survey process using tape calls to elicit responses. Survey points were established in a density of approximately 1/5 ha (12 ac) with most survey work being done by canoe. Tapes used featured 50 seconds of male territory vocalizations followed by 10 seconds of silence. Their results indicated that survey work for American bitterns was more successful when conducted early in the breeding season (May in Maine) and day (before 8 A.M.)

**Comments:**

Current information on the natural history of this species is lacking as well as information on its New Jersey abundance and distribution.

**Regulatory Guidelines:**

1. Area of Documentation: Wetlands or wetlands complex featuring a documented record based on a sighting, specimen, or call. Size of area designated will be evaluated on a case by case basis, however Gibbs and Melvin (1992) suggested a minimum size of 2.5-5 ha (5-12.5 ac.) of contiguous wetland habitat for nesting and also suggested protecting smaller surrounding wetlands for alternative foraging sites.

2. Suitable habitat: Areas of emergent marsh habitat which features cattails, bullrushes, and/or other wetland species described above. Mosaic wetland habitats will be evaluated on a case by case basis. Level of human intrusion into and around a wetland or wetland complex will also influence the suitability of such areas to support bitterns.

**Rationale:**

Little information is available on the spacial requirements for this species. What information is available suggests that the species may be area dependent and that as a breeder, bitterns are extremely susceptible to disturbance. Designation of the extent of exceptional resource value wetlands must be sensitive to these concerns while remaining flexible enough to adapt to yet unidentified spacial and habitat requirements.

**Primary Author(s):**

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Walsh, J., V. Elia, R. Kane, and T. Halliwell. 1999. American bittern (*Botaurus lentiginosus*) pgs. 78-80 in Birds of New Jersey. New Jersey Audubon Society. 704 pp.

**Species**: **Bobolink (*Dolichonyx oryzivorus*)**

**Status: State threatened**

**New Jersey Distribution**:

Bobolinks occur widely in New Jersey in localized areas of early succession field, meadow, agricultural lands, and airports. New Jersey breeding bird atlas surveys found populations to be largely concentrated in Hunterdon, Warren, and Sussex counties in north Jersey and Salem and Burlington counties in south Jersey (Walsh et al. 1999)

**Suitable habitat:**

In general, bobolinks breed in hayfields, meadows, marshes and fallow fields featuring taller grasses and forbs (DeGraaf and Rudis 1987; Ehrlich et al. 1988). Moist habitats may be preferred over drier areas for foraging and breeding (Whittenberger 1978; Whittenberger 1982; DeGraaf and Rudis 1987).

In Oregon, habitats used by bobolinks were characterized as grassy meadows intermixed with sedges (*Carex* spp.) and forbs. Cow parsnips (*Heracleum lanatum*), fences, and scattered willows (*Salix* spp.) were used as perch sites (Whittenberger 1978). Major forb species present included dandelions (*Taxaracum officinale*), cinquefoil (*Potentilla glomerata*), yarrow (*Achillea millefolium*), Canadian thistle (*Cirgium arvense*), false lupine (*Thermopsis montana*) and mallow (*Malva moschata*). Minor species included sweet clover (*Melilotus officunalis*), bur clover (*Medicago lupulins*), red clover (*Trifoloum pratense*), vetch (*Vicia americana*), groundsel (*Senecio* hydrophilus), false Solomon's seal (*Smilacina stellata*), and pepper grass (*Lepidium perfodiatum*)(Whittenterger 1980).

In New York, boblinks studies by Martin (1974) occurred in floodplain habitat surrounded by forest. Sedges dominated the wetter areas while bluegrass (*Poa pratensis*) and meadow rue (*Thalictrum* spp.) dominated ridges and drier areas of the field. Habitats studied in New York consisted of hayfields and meadows featuring grasses (e.g. *Phleum pratense*; *Anthoxanthum odoratum*), forbs (e.g. *Solidago* spp., *Fragaria* spp., *Taraxacum* spp.), and saplings of dogwood and white ash (Gavin 1984).

Aside from the type of vegetation occurring in wetlands, the hydrologic characteristics of wetland habitats tend to influence use of these habitats by bobolinks. Studies in Oregon have indicated that males initially settle in areas of low sedge cover and high forb cover which are not flooded or too dry (Whittenberger 1978; Whittenberger 1982). Territories established in mesic and wet habitats were more productive than those established in dry habitats (e.g. greater numbers of monogamous and polygamous males vs. bachelor males) (Whittenberger 1980). In addition, wetter territories featured higher vegetational mass, growth and higher insect biomass.

**Survey methodologies:**

Surveys conducted by the Division of Fish, Game, and Wildlife, Endangered and Nongame Species Program checked suitable habitats four times every other week beginning the third week in May and extending through the last week of June. Routes began at sunrise and three minutes were spent listening at each stop (Kalka 1986)

**Regulatory Guidelines:**

1. Area of documentation: Contiguous wet field or meadow habitats documented to feature sightings of bobolinks.

2. Suitable habitat: Open fields and meadows dominated by early successional grass and forb species for nesting and scattered saplings/shrubs or fence posts for perch habitat. Minimum size of wetland habitat required within a larger complex of upland suitable habitat will be 0.74 ha (1.8 ac), the minimum documented bobolink territory size.

**Comments:**

Species is reliant on early successional habitats for nesting. Timing and frequency of mowing of field habitats greatly affects the success or failure of nesting bobolinks (Bent 1958; Weins 1969) Due to use of both upland and wetland habitats for "breeding, resting, and feeding", not all sightings of this species will lead to exceptional resource value classification determinations of adjacent wetlands. Presence/absence surveys may assist in establishing the suitability of succeeding habitats.

**Rationale:**

Studies on bobolink habitat use suggest a direct association between successful bobolink reproduction and wetland habitats. In addition, since the wetland habitats used by bobolinks feature subtle hydrologic characteristics (e.g. not too dry or inundated), the protection of the habitat and upland edges is crucial to maintaining the existing site hydrology.

**Primary Author(s):**

Larry Torok, NJDEP, Land Use Regulation Program

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**Species: Black Rail (*Laterallus jamaicensis*)**

**Status: State threatened**

**New Jersey Distribution:**

Historically, black rail populations have been concentrated in coastal marshes from the vicinity of Philadelphia into Cape May and along the Atlantic coast as far north as Sandy Hook in Monmouth County (Kievit 1980; Kerlinger and Sutton 1989). Inland reports come from Bergen, Morris, Mercer, and Camden County (D. Hughes in Davidson 1992). New Jersey breeding bird atlas surveys only confirmed breeding in one locale (Sussex County) and found possible or probable in 12 other locales along the coast and Delaware Bay (Walsh et al. 1999).

**Habitat:**

Black rails have been reported from both salt and freshwater marshes throughout their North American range. In New Jersey, the species has predominantly been found in salt and brackish water marshes but several scattered freshwater wetland records exist (Torok 1987).

Salt or brackish water habitats are characterized by stands of saltmeadow cordgrass (Spartina patens), mixed with saltwater cordgrass (*S. alterniflora*), big cordgrass (*S. cynosuriodes*), marsh spike grass (*Distichlis spicata*), black needlerush (*Juncus roemerianus*), black rush (*J. gerarde*), or olney's bulrush (*Scirpus americansis*) (Kerlinger and Sutton 1988; H. Wierenga in Davidson 1992). Other species mixing in along upland/wetland fringes include marsh elder (*Iva frutescens*) and groundsel tree (*Baccharis halimifolia*) (Kerlinger and Wiedner 1990). Succession from saltmeadow to saltwater cordgrass dominated communities is reported to adversely impact the suitability of salt marsh habitats for black rails (Kerlinger and Sutton 1988). Nesting locales typically occurred in areas flooded by only unusually high tides (Todd 1977; Andrle and Carroll 1988).

Rails nesting in inland areas generally occur in wetland complexes dominated by sedges, rushes, and grasses (Todd 1977; Proctor 1981). Use of cattail (*Typha* spp.) and oat(*Avena sativa*) habitats has also been recorded (Bryant 1962; Armistead 1990). In a study of black rail habitat use along the lower Colorado River in Arizona, Repking and Ohmart (1977) concluded that black rails were closely associated with wetland communities which:

a. were dominated by three-square bulrush;

b. featured gently sloping shorelines; and

c. experienced a minimum of water level fluctuations.

Shallow water levels, between 2-4 cm (0.8-1.4 in), have been identified as typical of rail habitat in this area (R. Flores in Davidson 1992).

**Survey methodologies:**

Repking and Ohmart (1977) surveyed for black rails from the periphery of marsh habitats using taped calls. Surveys were conducted from approximately one hour before sunrise to 10.00 A.M. Taped calls were played every 40 m (132 ft) for 3-5 minutes with an additional 2 minute listening period after. Kerlinger and Sutton (1988) searched suitable south Jersey habitats using listening periods consisting of a 3-5 minute listening session upon arrival, followed by a 1-3 minute tape call. The process was then repeated. Between 10-30 minutes were spent during each survey session depending on site conditions. Surveys in Maryland were conducted in the evening between 10 p.m. and 4 a.m. from roadside survey points (H. Wierenga in Davidson 1992).

**Regulatory Guidelines:**

1. Area of documentation: Refer to Appendix 1, Section I above.

2. Suitable habitat: Freshwater or regulated brackish water wetland marshes or wetland fringes featuring a species composition similar to that described above will be considered suitable habitat.

**Rationale**

While black rails principally occur in saltwater or brackish water marshes in New Jersey, a freshwater wetland fringe is frequently found between the tidal wetlands and uplands. Evidence suggests that black rails prefer habitat along the "drier" edges of these marshes and make extensive use of these transition zones. Habitat in these areas is susceptible to the invasion of more aggressive species, such as Phragmites, and a subsequent reduction in suitability for black rail use if changes in site hydrology or vegetational structure occur. In addition, the "drier" areas of the marshes provide refugium from high tide events, activities which can reduce reproductive success (Bailey 1927; Todd 1977) and causes increased predation (Evans and Page 1986) on black rails.

As a result, the protection of these fringe freshwater wetlands is important to maintaining continued existence of black rails in New Jersey. The protection of these "drier" wetland habitats and adjacent upland buffer is paramount in maintaining the suitability of the habitat for black rails. In a discussion on habitat protection efforts for this species, Davidson (1992) suggested that preserve design should encompass suitable breeding habitat and a secondary ecological boundary of marshland and upland areas. This proposal is consistent with these recommended protection actions.

**Comments:**

Due to the infrequent occurrence of black rails in interior freshwater wetlands, the Department will evaluate the habitat conditions surrounding reported inland sightings and make classification determinations on a case by case basis. It is likely that similar standards to those proposed of coastal wetlands will be applied.

**Primary Author(s):**

Larry Torok, NJDEP, Land Use Regulation Program.

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Walsh, J., V. Elia, R. Kane, and T. Halliwell. 1999. Black Rail (*Laterallus jamaicensis*) pgs 208-209 in Birds of New Jersey. New Jersey Audubon Society. 704 pp.

**Name: Red-headed woodpecker (*Melanerpes erythrocephalus*)**

**Status: State threatened**

**New Jersey Distribution:**

Historically, red-headed woodpeckers ranged throughout the state but were always more abundant in the north than south. New Jersey breeding bird atlas surveys found widely scattered potential breeding sightings, but only confirmed the species at six sights in four counties (Hunterdon, Burlington, Atlantic and Cape May counties) (Walsh et al. 1999).

**Suitable Habitat**:

The species may breed in a variety of habitats including river bottom forests, wood swamps, beaver ponds, open deciduous groves, orchards, and agricultural areas (Wilson 1970; Reller 1972). Habitats used by the species are characterized by scatterings of mature trees with an open or herbaceous understory or forest edge associated with nearby open areas (Conner 1976; Hardin and Evans 1977).

Nest cavities are usually in dead trees or, less frequently, dead limbs in living trees (Reller 1972). Red-headed woodpeckers prefer vertically facing cavities and limbs without bark. Nest cavities are usually excavated from existing indentations or cracks (Reller 1972; Jackson 1976). Nests are typcially located 7-12.4 m. (23-40 ft) above the forest floor, though they have been documented as high as 24.2 m. (80 ft) (Bull 1975).

Tree species used for nesting in New Jersey include red maples (Acer rubra), oaks (Quercus spp.) and pitch pine (*Pinus rigida*)(Cromartie 1982). Graber et al (1977) reported the species to nest in a bottom land forest characterized by oaks, hickories (*Carya* spp.), elms (*Ulmus* spp.), and hackleberry (*Celtis* spp.). Wander and Brady (1980) reported the species to nest in a forest stand characterized by scattered pitch pines (*Pinus rigida*) with an understory of oak sprouts, and a sparse ground cover of lowbush blueberry (Vaccinium vacillans) and huckleberry (*Gaylussacia* spp.) in the Pine Barrens. They also identified a "probable" nest site in a roadside utility pole. A wetland nesting site in Sussex County is characterized as a seasonally flooded sedge meadow featuring numerous standing dead trees interpersed and bordered by hardwood forest (L. Torok, pers. comm).

A study on woodpecker foraging characteritics in a Texas bottomland forest indicated that red-headed woodpeckers favored dead trees over live, foraged largely on tree trunks, and did not vary foraging heights when changing foraging substrates (e.g. live trees vs. dead)(Conner et al. 1994). This study also showed a significant preference for oak species over all other tree species in the forest for foraging. The presence of mast producing tree species has also been suggested as an important component to wintering habitat for the red-headed woodpecker (Kilham 1958).

**Survey methodologies:**

No standard methodology has been recommended for this species. Most survey work consists of searching suitable habitats during the breeding season for this species.

**Regulatory Guidelines:**

1. Area of documentation: Due to the lack of information on the spatial requirements of the red-headed woodpecker and the variability in the information available (e.g. 0.5-20 ha in Virginia), no firm standard can be applied to define an "area of documentation" for all documented sites. The extent of habitat evaluated will largely depend on information on the species occurrence (i.e. one pair, several pairs, frequency of presence etc.) and the amount of suitable habitat present and will be established on a case by case basis.

2. Suitable habitat: Hardwood or softwood stands featuring the vegetative characteristics described above. Key characteristics include an open understory and the presence of snags and/or dead limbs to provide suitable nesting habitat. It should be noted that use is also made of atypical sites (e.g. utility poles, orchards) so these crtieria are not inclusive.

**Comments**

Red-headed woodpeckers occur in upland and wetland habitats. As a result, not all sightings of the species will result in exceptional resource value wetland classifications.

**Rationale**

Without more data on the spatial requirements of the red-headed woodpecker, the amount of wetland habitat to be considered when making an exceptional resource value classification determination will be driven by sighting specific information and the extent of suitable habitat available contiguous with the area(s) where the species has been observed. Flexibility on the type of habitat determined to constitute "suitable habitat" is necessary due to occassional use of atypical habitats.

**Primary Author(s):**

Larry Torok, NJDEP, Land Use Regulation Program.

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**Species**: **Osprey (*Pandion haliaetus*)**

**Status: State threatened (breeding population)**

New Jersey Distribution: New Jersey's osprey population is largely concentrated along the Atlantic coast and back bays, along the Delaware Bay shore and up several large river channels (Walsh et al. 1999). Inland breeding populations have historically occurred in Passaic County and also along the upper Delaware River. Currently one nest site is known from along the Delaware River. No inland nests have been recently documented despite numerous sightings.

**Suitable habitat:**

In general, ospreys are associated with riverine, lacustrine, or coastal waterbodies or bays which feature suitable populations of fish (Bent 1937; Wood 1979; Brown and Amadon 1968 in Vana-Miller 1987).

Breeding habitat: Ospreys will nest on a variety of structures including living or dead trees (Roberts 1969; French 1972; D.L. MacCarter 1972; Postupalsky 1977; Henny et al 1978); utility poles (Prevost 1977), channel markers (Reese 1970; Wiemeyer 1971) and artificial nest platforms (Reese 1977; Postupalsky 1978). The particular species, height, and surrounding tree density, do not appear to be critical to nest site selection (Bent 1937; Swenson 1975; Richardson 1980). Characteristics which do appear important include proximity to suitable feeding habitat and exposed view of surrounding areas from the nest (Postupalsky and Stackpole 1974; Swenson 1975; Grover 1983).

Ospreys studied by Van Daele and Van Daele (1982) in Idaho favored snags (66%) and live trees (19.7%) over utility poles (8.7%) and nest platform (5.5%). Nest tree heights in studied populations have proved highly variable. These include 7.6 m (25 ft)-39.6 m (130 ft) (D.L. MacCarter 1972) and 4.8 m (15.7 ft)-27.2 m (89 ft) (Grover 1983) in Montana, 9 m (29.5 ft)-27 m (88.5 ft) in Minnesota (Dunstan 1973), 2 m (6.6 ft)-49 m (160.7 ft) in California (Garber 1972), and 15.7 m (51.5 ft)-30.3 m (99.4 ft) in New Hampshire (Smith and Ricardi 1983).

Roosting Habitat: Little documentation exists on the habitats used by roosting ospreys. It is expected that forest stands similar to nesting habitat are used.

Feeding Habitat: Suitable foraging habitats for osprey are generally any water body featuring populations of fish of suitable size. Reservoirs, lakes, rivers and coastal bays and inlets are favored locales. Hughes in Vana-Miller (1987) suggested a range of prey size from 15-35 cm (6-14 in). Poole (1989) reported most fish taken were between 25-35 cm (10-14 in). Various studies have identified a wide variety of fish species will be taken by osprey [See Table 1 in Vana-Miller (1987) for more details]. Based on these data, it is generally believed that the abundance or availability of prey is more critical than the type of species present (Prevost 1977; Flook and Forbes 1983).

No standards for minimum size have been applied to establish the suitability of a particular water body for osprey foraging. Generally, suitable habitats must be free of dense emergent or submergent vegetation and also dense, overhanging vegetation from the banks or shore which may obstruct hunting birds and provide cover for prey species(Hynes 1970; Postupalsky and Stackpole 1974; Prevost 1977). Water clarity is another factor which influences the ability of ospreys to detect and capture prey (Flook and Forbes 1983). Favored perch sites are similar to nest habitat, being live or dead trees, buoys, channel markers, nest platforms, or utility poles (Berger and Mueller 1969; Wiemeyer 1971; MacCarter 1972; Prevost 1977; Rhodes 1977).

Human Disturbance: Another factor which influences the suitability of a habitat for the osprey is the timing and level of human disturbance experienced by a habitat. Many cases of osprey nesting in "disturbed" areas exist (e.g. Reese 1970; Poole 1980; Poole and Spitzer 1983). However, the disturbance at these sites was largely continuous throughout the nesting cycle and ospreys exhibit the ability to habituate to certain types of disturbance. Other studies have indicated that the timing (i.e. during nest construction or incubation) and frequency of the disturbance (i.e. sporadic, inconsistent) was critical to its impact on nesting ospreys (e.g. French 1972; Garber 1972; Reese 1977; Van Daele and Van Daele 1982; Poole and Spitzer 1983). To offset these impacts, several researchers suggested critical distances from the nest within which human disturbance could have adverse impacts. These distances ranged from 0.2-1.5 km (0.12-0.9 mi) (Garber et al. 1973; Swenson 1975; Van Daele and Van Daele 1982; Postupalsky in Vana-Miller 1987). However Poole (1989) cautions that such distances are not a panacea to effective protection of nesting ospreys.

**Survey methodologies:**

Aerial surveys are conducted in New Jersey during May and June (J. Sciascia pers. comm.; K. Clark pers comm.). These surveys consist of 1-3 hour periods initiated either at sunrise or 3 hrs before sunset searching suitable water-bodies for flying or perched birds. Observed osprey are followed visually to roosts or nests.

**Regulatory Guidelines:**

1. Area of documentation: Refer to Appendix 1, Section I above.

2. Suitable habitat: For breeding habitat, all contiguous forest, scrub-shrub, or emergent wetlands within the "breeding" radius around a nest site. Foraging habitat will be waterbodies featuring the habitat and prey characteristics described above.

**Comments:**

Currently, only one or two nests occur in inland areas. Recent nesting along the upper Delaware and an increase in sightings of osprey inland suggests that the species may be returning as a breeder to freshwater water bodies. Further review and refinement of the existing guidelines will be necessary as the inland breeding population increases. Osprey nests in the vicinity of the Delaware Bay are still being impacted by contaminants (Griffin and Steidl 1990; K. Clark pers. comm.).

**Rationale:**
The breeding population of osprey in New Jersey is listed as threatened. As a result, the classification of wetlands as being of exceptional resource value will focus largely on maintaining the suitability of known nest sites. Currently, most sites occur in coastal areas. For these nesting locales, the designation of fringe freshwater wetlands within proximity of a documented osprey nest site will assist in controlling new human related disturbance factors on the nesting birds within the "critical distance" of up to 1 km of a nest (Vana-Miller 1987). It must be noted that the Department will evaluate existing conditions when making these determinations in that levels of disturbance around nest sites is highly variable (i.e. a nest site on a light pole in a 7-11 parking lot vs. a nest on a platform in undisturbed marsh). The protection of inland nest sites will be of critical importance to the re-establishment of this species as a breeder in historic habitat and is also significant in meeting the overall recovery goals for this species.

**Primary Author(s):**

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**Name: Barred Owl (*Strix varia*)**

**Status: State threatened**.

**New Jersey Distribution:**

Entire State is considered within this species range. Major populations occur along the Kittatinny Mountains in northwest Jersey, within the Newark Watershed in Passaic County, within the Passaic River basin in Morris County, and in large swamp complexes in Cape May and Cumberland Counties. Barred owls were found 149 grids during New Jersey breeding bird atlas surveys but were nearly absent in 9 of 21 counties (Walsh et al. 1999)

**Suitable Habitat:**

Barred owls are known to occur in both upland and wetland habitats with home ranges typically composed of a mosaic of upland and wetland areas. Suitable habitats are generally described as large tracts of either hardwoods, softwoods, or mixed stands (Soucy 1982; Sutton and Sutton 1985) though Falk (1990) felt that the species may be more of a habitat generalist, being habitat flexible contingent upon the presence of large trees with suitable cavities. However, in New Jersey, differences exist between habitat used by barred owls in the coastal plain and that used in the highland and ridge and valley physical provinces.

In northern New Jersey, Bosakowski et al.(1987) reported preferential use of oak hardwood (*Quercus* spp., *Carya* spp., *Fraxinus americana*, *Acer rubrum*, *Betula lenta*, *Tilia americana*, *Liriodendron tulipera*, *Prunus serotina*, and *Nyssa sylvatica*), northern hardwood (*Acer sacchrum*, *Betula alleghaniensis*, and *Fagus grandifolia*), and hemlock (*Tsuga canadensis*) forests. Ninety-five percent of barred owl locations were within 100 m. (328 ft.) of a watersource. In addition, photo analysis of 27 barred owl locations revealed a significant overutilization of wetlands (9.4%) compared to 20 unused sited (5.9%)(Bosakowski 1990). This data shows that wetland areas required by barred owls do not have to be large to be suitable for use by this species.

Using radio telemetry, Nicholls and Warner (1972) established Minnesota barred owls to use the following habitats, listed in order of preference; oak *(Quercus* spp.) woods, mixed hardwoods and conifers, white cedar (*Thuja occidentalis*) swamp, alder swamp, emergent marsh, and open field. Further analysis showed that the oak, mixed, and conifer forests were preferred over the other habitat classes listed. The oak woods featured overstory heights of 6.1-19.8 m (20-65 ft) with little understory vegetation. The mixed and conifer stands featured various combinations of sugar maple, basswood (*Tilia americana*), red oak (*Quercus rubra*), white birch (*Betula papyrifera*), northern pin oak (*Quercus palustrus*), white pine (*Pinus strobus*), red pine (*Pinus resinosa*), and jack pine (*Pinus banksiana*). Understory vegetation was sparse. Conifer swamps consisted of white cedar and tamarack (*Larix laricina*) dominated stands. Other studies in northern areas (e.g. Michigan, Connecticut, New Hampshire, Virginia) have also confirmed barred owl use of similar habitat types (Smith 1978; Elody 1983; Hegdal and Covin 1988).

In their analysis of barred owl habitat use in southern New Jersey, Laidig and Dobkin (1992) found barred owls to be primarily associated with three habitat types; Atlantic white cedar (*Chamaecyparis thyoides*) swamp, pitch pine (*Pinus rigida*) lowland habitat, and hardwood swamp. Cedar swamp habitats featured typical understory vegetation of sweetbay (*Magnolia virginiana*) and highbush blueberry (*Vaccinium corymbosum*), while pitch pine lowlands featured inkberry (*Ilex glauca*) and highbush blueberry. Overstory tree species in hardwood swamps included tulip-tree (*Liriodendron tulopifera*), sweet gum (*Liquidambar styraciflua*), black gum (*Nyssa sylvatica*), and red maple (*Acer rubrum*). Understory species were the same as those in the softwood swamps. In both cases, understory vegetation was considered dense and often contained large amounts of catbriar (*Smilax* spp.). See Laidig (1992) for additional details on the habitat types covered under this study.

Breeding habitat: The USFWS HEP model for the barred owl (Allen 1987), summarizes barred owl reproductive requirements in the following fashion. Nesting habitat in North America is described as mature stands of elm (*Ulmus* spp.), beech (*Fagus* spp.), oaks, hickories (*Carya* spp.), yellow birch (*Betula alleghaniensis*), sycamore (*Platanus occidentalis*), and aspen (*Populus* spp.). Typical nesting trees are large [greater than 50.8 cm (20 inches)], living or dead trees. Nesting cavities are generally found 9 meters (12 feet) above the ground. Falk (1990) reported a strong relationship between sugar maples (*A. saccharum*) and barred owls nests in Connecticut. Nests have also been recorded in broken snags or in abandoned hawk nests. Barred owls have also used artificial structures for nesting (Johnson 1987).

In New Jersey, Bosakowski et al (1987) found three nests in large dead trees which included white oak (*Quercus alba*), sugar maple, and black willow (*Salix nigra*). In south Jersey, barred owls have been identified as likely breeders in Atlantic white cedar swamps and pitch pine habitats (Sutton pers. comm.). Neither researcher reported barred owl use of hawk or great horned owl nests. A pair of barred owls were identified as breeders in a red maple swamp in Cumberland County (Ormiston 1991). Valent (pers. comm.) recorded a barred owl nest in a sycamore near a single family house in Warren County.

Feeding and Resting habitat: Nicholls and Warner (1972) postulated that the low use of alder thickets and white cedar swamps by barred owls was a function of one or more of the following characteristics; high stem densities, fewer suitable nest and perch sites, fewer prey, and/or the muffling affect of the wet vegetation. Similar findings were made by McGarigal and Fraser (1984) in Virginia and Devereux and Mosher (1984) in Maryland. Laidig and Dobkin (1992) suggested that barred owls foraged along the open areas adjacent to cedar bogs where various rodent prey are know to occur and also in less favorable oak-pine upland habitats which feature less dense understories than wetland habitats. D. Dobkin (pers. comm.) also indicated that the barred owl's ability to pounce on prey from above rather than swoop in laterally may permit the species to hunt in the denser forest understories typically found in the pine barrens.

Little information exists of habitats used by roosting owls. Dense cedar stands have been documented to be used by roosting owls (Applegate 1975; Fuller 1979). Laidig and Dobkin (1992) suggested that such habitats may also provide a thermal refugium from hot temperatures during the summer

Other factors: Human disturbance and structures impact the suitability of forested habitat for the barred owl. In Connecticut and New Hampshire, Smith (1978) reported barred owls to strongly avoid areas containing multi-family dwellings, commercial and institutional buildings, and open water areas. In the Pequannock Watershed of New Jersey, Bosakowski (1990) determined that 27 barred owl locations were further from human habitation, had fewer houses, and had reduced suburban areas compared to 20 unused sites. Contrary to these findings are the pair of owls found in a suburbanized area of English Creek in Atlantic County (Sutton 1989) and the nesting pair near a single family dwelling in Warren County (Valent pers. comm.; L. Torok, pers. comm.). Great horned owls (*Bubo virginianus*) are well documented predators of barred owls (Bent 1938; Grant 1966; Fuller 1979). Laidig and Dobkin (1992) suggested that competition for prey items between the two species may also occur while Bosakowski (1990) found that competition for food with great horned owls was moderate, but below critical levels. Home range overlap between these two species appeared to varied between north and south; with great horned owls sharing 35% of areas surveyed in southern Jersey vs. 7.5% in the Pequannock Watershed (Bosakowski 1990; Laidig 1992)

**Survey requirements;**

Dobkin and Laidig (1990) surveyed for barred owls using taped vocalizations consisting of six 10 second sets of barred owl vocalizations followed by 50-60 seconds of silence. The tape player speaker was rotated 180 degrees between each 10 second interval for a period of five minutes. A listening period of five minutes followed each tape sequence. Survey points were located approximately 1 km (0.6 mi) apart. Surveys should be conducted after sunset, when wind speeds are less than 8 mph, and when precipitation was absent, light or intermittent (Valent 1987). While barred owls may respond to tape calls during any month of the year, greater success has been documented during March-July (Bosakowski et. al. 1987). Smith (1978) reported greater owl response success during May-July and after 8:00 P.M.

**Regulatory Guidelines:**

1. Area of documentation: Contiguous forest parcels associated with known breeding locales. See forest mapping discussion in Section 1.

2. Suitable habitat: See the discussion provided above for details on species composition, plant community age, and surrounding land uses. The evaluation of each wetland will take into account the following characteristics:

a. Locational factors: proximity to residential, industrial, or commercial development, density of development, other human disturbance factors, agricultural lands, and forest block size and continuity.

b. Vegetative factors: forest age, canopy height, canopy closure, species composition, understory height, stem density, species composition.

**Comments**:

As discussed above, great horned owls are known to be a predator/competitor of barred owls. While their ranges have been documented to overlap (Bosakowski 1990; Laidig and Dobkin 1992, Kane pers. comm), the presence of this species in areas featuring barred owls will affect the suitability of a particular habitat to support barred owls.

**Rationale**

While barred owls will use both upland and wetland habitat, in New Jersey they are primarily associated with forested wetlands. Falk (1990) suggested that the association between barred owls and wetlands is related to a number of factors including prey base, the protection provided by the denser forest cover associated with wet areas, and the greater number of large, decadent trees present there. In addition, barred owls are an area dependent species. Studies have demonstrated that breeding pairs will make use of suitable habitats over large (up to 2400 acres) of land (Hedgal and Colvin 1988). Most barred owl "documentation" consists of responses to tape calls which identify the species at a particular locale but does not always provide habitat specific information.

The identification and protection of suitable freshwater wetland habitats within likely home range "areas" offers the best protection strategy for ensuring the continued existence of the barred owl within currently occupied habitats. The success of such a strategy is contingent upon the size and configuration of wetland habitats in relation to the eventual degree of upland development within each particular barred owl "area of documentation".

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**Species:** **Migratory raptors**

**Status:** **State Endangered**

bald eagle (*Halieetus leucocephalus*) #
red-shouldered hawk@ (*Buteo lineatus*)
northern harrier* (*Circus cyaneus*)
peregrine falcon (*Falco peregrinus*)
Cooper's hawk (*Accipiter cooperii*)

**Threatened**

northern goshawk (*Accipiter gentilis*)
osprey* (*Pandion haliaetus*)

# federally threatened.
*state listing for breeding status only; species breeds, migrates and/or overwinters in Cape May.
@breeding population endangered, wintering population threatened.

**Suitable habitat**

Habitat types which can be expected to be used by each of the seven species identified above during the migration period of September 1 to December 1 are described below. In general, migratory raptors are associated with vegetative communities structurally similar to those used during the breeding season unless otherwise noted. Other factors which affect the suitability of habitat for breeding use, such as human disturbance, competition, and predation, play a less important role in the determining the suitability of a particular habitat for use by migrating birds.

Bald eagle

Preferred foraging habitat for bald eagles are rivers, lakes, and estuaries (DeGraaf et al. 1980). The primary prey item for eagles is fish, though they will also take various species of birds, reptiles, mammals, and invertebrates (Retfalvi 1970; Dunstan and Harper 1975; DeGraaf et al. 1980; Cline and Clark 1981; Todd et al. 1982; Frenzel 1984).

Trees in proximity to water are the favored perch site for eagles (Stalmaster and Neuman 1979; Steenof et al 1980; Chester et al. 1990). Perch sites generally consisted of tall (mean 21.1 m/69 ft), large (mean 42.3 cm/17 in) trees featuring stout, horizontal branches with at least one side facing an open area (Steenof et al. 1980).

Roost habitat tends to be located near water and feature mature living or dead hardwoods or softwoods (Steenof 1978; Keister and Anthony 1983; Stalmaster and Gessaman 1984; Keister et al. 1985; Buehler et al 1991)

Cooper's hawk

Cooper's hawks are considered a species associated with deciduous, mixed, or evergreen forest and open woodlands, including woodlots, riparian forest, and conifer plantations (Reynolds et al. 1982; Evans 1982; Bosakowski and Smith 1989). When occurring in forested habitat, the species commonly uses ecotones along vegetative community edges, roads, or in patches or groves (Johnsgard 1990). In northern Jersey, Bosakowski et al. (1992b) indicated that Cooper's hawks are associated with mature and submature stands with a moderately dense understory. The species primarily feeds on birds in the eastern United States (Storer 1966; Wattel 1973; Bosakowski and Smith 1992). During migration, Cooper's hawks have been documented to use a much wider variety of habitats; basically being associated with any habitat containing trees or shrubs (Evans 1982; Palmer 1988; Johnsgard 1990).

Northern goshawk

In the Pequannock Watershed of northern Jersey, Speiser and Bosakowski (1984) characterized goshawk habitat as mature to overmature forest with a slight to moderate amount of understory vegetation. Associated tree species were American beech (*Fagus grandifolia*), black birch (*Betula nigra*), White pine (*Pinus strobus),* eastern hemlock (*Tsuga canadensis),*Atlantic white cedar (*Chamaecyparis thyoides*), oaks (*Quercus* spp.), and red pines (*Pinus resinsa*). Understory species include hazelnut (*Corylus americana*), dogwood (*Cornus* spp.), mountain laurel (*Kalmia latifoli*a), serviceberry (*Amelanchier* spp.), and blueberry (*Vaccinium* spp.)(Speiser and Bosakowski 1987). Wood roads and other cleared areas may be used for hunting. Winter foraging often occurs over a broader range of habitat types than does breeding activity, with various open environments like shrub communities or parklike foothills being used (Johnsgard 1990). Commonly hunts in or below the forest canopy (Palmer 1988).

Norther harrier

Northern harriers are primarily a species of the open country; occurring in such habitats as farm fields, salt and freshwater marshes, swamps, bogs, and wet meadows (Hall 1983; Laughlin and Kibbe 1985; Serrentino 1989). Freshwater wetland vegetation occurring in harrier habitats include meadowsweet (*Spiraea latifolia*) and red-osier dogwood (*Cornus stolonifera*), sedges (*Carex* spp.), bulrushes (*Scirpus* spp.), goldenrod (*Solidago* spp.), willow (*Salix* spp.) and wet hayfields dominated by reed canary grass (*Phalaris arundinacea*) (Serrentino 1987; Hamerstrom and Kopeny 1981; Laughlin and Kibbe 1985). Coastal habitats feature northern bayberry (*Myrica pensylvanica*), black huckleberry (*Gaylussacia baccata*), wild rose (*Rosa* spp.), common reed (*Phragmites australis*), salt hay grass (*Spartina patens*), smooth cordgrass (*S. alterniflora*), and poison ivy (*Toxicodendron radicans*)(Holt and Melvin 1986; Dunne 1984; England 1989).

Osprey

Ospreys primarily feed upon fish and forage in estuarine, river, and lake habitats during migration. Water bodies should be free of dense emergent or subemergent vegetation and also dense, overhanging vegetation from the banks or shore (Hynes 1970; Postupalsky and Stackpole 1974; Prevost 1977). Favored perch sites are similar to nest habitat, principally being live or

dead trees, but also buoys, channel markers, nest platforms, or utility poles (Berger and Mueller 1969; Wiemeyer 1971; MacCarter 1972; Prevost 1977; Rhodes 1977). Little is documented in regard to osprey roost habitat.

Peregrine falcon

Peregrine falcons in New Jersey feed primarily on avain prey (Steidl 1989). Foraging habitats are usually open areas such as lakes, rivers, and marshes where prey are abundant and vulnerable (Evans 1982; Palmer 1988). During migration, peregrines will use open areas (e.g. fields), forest and ecotones to forage on passerine prey (K. Clark pers. comm).

Red-shouldered hawk

A review of the literature indictes that red-shouldered hawks are commonly associated with habitats varying from lowland hardwood, mixed, and conifer forests to upland mixed and conifer forests (Henny et al. 1973; Bednarz and Dinsmore 1981; Titus and Mosher 1981; Crocoll and Parker 1991). Surrounding habitats were almost always characterized by nearby waterbodies (e.g. swamps, rivers, ponds) and tracts of forest (Kimmel and Fredrickson 1981; Morris and Lemon 1983; Bosakowski et al.1992a). In a study of south Jersey breeding habitats, red-shouldered hawks were commonly associated younger aged wet woods typified by Atlantic white cedar, red maple (*Acer rubrum*), black tupelo (*Nyssa sylvatica*), sassafrass (*Sassafras albidum*) and sweetbay (*Magnolia virgiana*) with surrounding habitats of oak-pine forest and agricultural fields (Dowdell and Sutton 1992).

**Survey methodologies**

Additional information on the techniques used for the Cape May studies cited above and their applicability to a particular site may be obtained from the Endangered and Nongame Species Program, NJDEPE, Division of Fish, Game, and Wildlife, 501 East State Street, Trenton, New Jersey 08625.

**Regulatory Guidelines:**

1. Area of documentation: The lower 10 kilometers (6 miles) of the Cape May peninsula. Identifiable by Universal Transverse Mercator line 43.18 on U.S.G.S. suvey quadrangles Rio Grande and Stone Harbor.

2. Suitable habitat: Vegetational communities featuring the following characteristics will be considered to provide habitat for one or more of the species described above.

a. Deciduous, mixed, or evergreen wetland forest.

i. Mature trees of a dbh of 20 cm (8 in) or greater.

ii. Canopy height of 6.1 m (20 ft) or greater.

iii. Snags and dead and down material.

vi. Shrubby understory vegetation. Density of shrub layer affects suitability for raptor foraging habitat.

b. Deciduous, mixed, or evergreen scrub-shrub wetlands.

i. Overstory height of < 6.1 m (20 ft).

ii. Songbird food and cover plants including, but not limited to:

winterberry holly (*Ilex verticillata*)
poison ivy (*Toxicondendron radicans*)
elderberry (*Sambucus canadensis*)
willow oak (*Quercus phellos*)
red maple (*Acer rubrum*)
honeysuckle (*Lonicera* spp.)
red cedar (*Juniperus virginiana*)
Virginia creeper (*Parthenocissus quinquefolia*)
wild cherry (Prunus spp.)
winged sumac (*Rhus copallina*)
hackberry (*Celtis* spp.)
grape (*Vitis* spp.)
holly (*Ilex opaca*)
pokeweed (*Phytolacca americana*)
sourgum (*Nyssa silvatica*)
sassafras (*Sassafras albidum*)
waxmyrtle (*Myrica certifera*)
goundsel tree (*Baccharis halimifolia*)
(Sutton 1989)

c. Freshwater or tidal emergent wetlands.

i. ground cover plants such as:
phragmites
sedges
rushes
salt meadow cordgrass
saltmarsh cordgrass
tall cordgrass (Spartina cynosuriodes)
cattails (*Typha* spp.)
hightide bush (*Iva frutescens*)
red cedars
red maple

ii. Any of the songbird food plants described above.

iii. Interspersed open water areas.

Wetland complexes that feature an interspersion and juxtaposition of these habitat types are of greater value than monotypic stands. Maintained areas (e.g. lawns, detention basins) will not be considered as suitable habitats

3. Other factors affecting habitat suitability: The size of the wetland complex associated with a property and the amount of human disturbance present will impact the suitability of the site for use by migratory raptors. As a rule, isolated wetland habitats less than 0.4 ha (1 ac) in size will not be considered a suitable habitat unless: (a) the wetland is a component (i.e. within 150 feet) of a larger wetland complex; (b) the wetland and entire area of the 150 buffer is a component of a larger upland forest complex (see above description) and/or (c) a listed migratory raptor is observed using the wetland for "resting or feeding" during the migratory season as defined above. For monotypic wetland communities dominated by phragmites or cattails, the structural diversity of the upland buffer community and level of development or disturbance on and adjacent to the property will affect the suitability of the wetland habitat.

Varying levels of human activity have been demonstrated to alter migratory raptor use of fields and displace prey species at Higbee Beach Wildlife Management Area (Clark and Niles 1986; Niles and Clark 1987). As a result, the intensity of human disturbance experienced by a onsite wetland and the degree of surrounding development will also be evaluated on a case by case basis when determining the suitablity of wetland habitats for migratory raptor use.

**Rationale**

The wetlands of the Cape May peninsula have been documented as providing critical habitat for migratory raptors in studies conducted by the staff of the Cape May Bird Observatory and the Division of Fish, Game, and Wildlife (DFGW). Between 47,000 and 88,000 raptors occur on or above the peninsula during the fall migration period (Dunne and Sutton 1986). Kerlinger (1989) listed Cape May as one of the most significant locales for migratory birds in the world. At least eleven species of raptor have been documented during the migrations including both federal (peregrine falcon, bald eagle) and state (Cooper's hawk, red-shouldered hawk, northern goshawk, osprey, northern harrier) listed species. Up to 90% of these birds are immatures (Niles 1989).

Research conducted by the DFGW's Endangered and Nongame Species Program has further defined the importance of wetland habitats in the lower 10 km of the Cape May peninsula. Studies conducted for a 30 kilometer portion of the peninsula and, subsequently, the lower 10 kilometers have reached the following conclusions:

1. Accipiters, falcons, and ospreys generally increased significantly within 10 kilometers of the point while harrier and buteo numbers were largely evenly distributed over the entire peninsula (Niles 1986);

2. A 30% increase in residental development between 1972 and 1986 has resulted in a significant loss of natural habitats available for use by migratory birds in the lower 10 kilometers (Niles 1989)

3. A statisical analysis of raptor observation data indicates that migratory raptors numbers are evenly distributed throughout the lower 10 kilometers and that species tend to be associated with similar structural habitats as those used by breeding birds (L. Niles pers. comm.)

4. Rather than just flying over the peninsula and continuing south across Delaware Bay, raptors tend to concentrate in the lower 10 kilometer in general, and along the western half of the peninsula, in specific, and forage and roost for varying periods before continuing south (Holthuijzen et al. 1982; Niles 1986).

Based on these findings, the Department has concluded that wetland habitats in the lower 10 kilometers of the Cape May peninsula are of local, statewide and regional signficance to the maintenance of North American raptor populations. As a result, suitable wetland habitats within this area are determined to be of exceptional resource value.

**Primary Author(s):**

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DRAFTDATE: 08/08/94 UPDATE: 01/12/04

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**Name: Indiana bat (*Myotis sodalis*)**

**Status: State and federally endangered**

**New Jersey Distribution:**

Three known hibernacula occur in Morris County in Hibernia and Mount Hope. As of July 1999, known locations suitable as pre- and post-hibernation and summer foraging and roosting areas included 18 municipalities in Morris County. These include Boonton Town, Boonton Township, Denville Township, Dover Town, Hopatcong Borough, Jefferson Township, Kinnelon Borough, Mine Hill Township, Montville Township, Mount Arlington Borough, Mountain Lakes Borough, Parsippany-Troy Hills Township, Randolph Township, Rockaway Borough, Rockaway Township, Roxbury Township, Victory Gardens Borough and Wharton Borough. Essex, Hunterdon, Passaic, Somerset, Sussex, Union and Warren counties may also provide potential summer and winter habitat.

**Suitable Habitat:**

In New Jersey, Indiana bats require habitat for winter hibernation and summer roosting and foraging. The characteristics of each of the seasonal habitats is provided below.

Winter hibernation: Indiana bats mate and hibernate in limestone caves and open, abandoned mine shafts (hibernacula). Caves provide important locations for mating and hibernation. Bats mate from September to mid-October during autumn swarming, with most mating occurring during the first 10 days of October. Mating takes place on the ceilings of large rooms near the entrances to hibernacula. Females begin hibernation almost immediately after mating, while most males remain active into November and even December (Evans, et. al. 1985). *M. sodalis* is highly selective of hibernation sites. Hibernacula are typically medium sized caves with large, shallow passageways. However, suitability is also determined by the configuration of the cave so as to trap cold air and provide stable low temperatures that permit bats to maintain low metabolic rates and conserve fat reserves through the winter (USFWS 1999). During midwinter, ideal conditions inside caves include an average temperature of 37-43° Fahrenheit (Evans, et. al. 1985) and a relative humidity of 87 percent (Barbour and Davis 1969), though recent studies have suggested that humidity rates may reach as low as 55 percent in some instances (USFWS 1999). Throughout hibernation, bats periodically move to the coldest parts of the cave. In addition, hibernating bats will awake approximately every 8-10 days and spend an hour or more flying about the cave or move to other clusters elsewhere in the cave (Barbour and Davis, 1969).

Roosting habitat: During the summer, females commonly occupy maternity roosts in riparian and floodplain forests under the loose bark of dead or dying trees (Evans et al. 1985). They have also been found under the loose bark of living trees and in cavities of dead trees (Humphrey et al. 1977). The use of upland habitats is also becoming more common for some populations. Other factors influencing the suitability of a particular tree as a roost site include the tree's solar exposure, location in relation to other tree's, and the tree's spatial relationship to water sources and foraging areas (Garner and Gardner 1992; Farmer et al. 1997; USFWS 1999). A study in

Illinois by Garner and Gardner (1992) indicated that 75% of roost trees were upland species, while the other 25% were floodplain species. Tree species used as roost sites include, but are not exclusive to, American elm (*Ulmus americana*), slippery elm (*Ulmus rubra*), bitternut hickory (*Carya cordiformis*), shagbark hickory (*Carya ovata*), sweet pignut hickory (*Carya ovalis*), northern red oak (*Quercus rubra*), post oak (*Quercus stellata*), white oak (*Quercus alba*), silver maple (*Acer saccharinum*), sugar maple (*Acer saccharum*), cottonwood (*Populus deltoides*), green ash (*Fraxinus pennsylvanica*) and sassafras (*Sassafras albidum*). Another study reported a colony found roosting in the cavity of a dead sycamore (*Platanus occidentalis*) (Kurta, et. al. 1993). However, tree characteristics are considered a greater determinant of roost suitability than species (Farmer et al. 1995; USFWS 1999; MacGregor, pers. comm. in USFWS 2000). Various studies have suggested that Indiana bats show strong site fidelity to summer colony areas (Humphrey et al. 1977; Gardner et al. 1991; Callahan et al. 1997). In a recent development, Indiana bats have also been documented to use buildings in Pennsylvania(Hassinger and Butchkoski 2001).

Maternity colonies may establish both primary and alternate roost sites, which differ in the number of bats using the site and the location of the roost site. Since the temperature of the roost site is important, primary roosts are often located with southeast or south-southwest exposures in areas that can be heated by the sun, such as in openings or at the edges of forests. Alternate roost sites are also located in forest interiors, and are used when temperatures are above normal or when it is raining (Callahan 1993). Use of up to 17 roost trees has been documented for a single Indiana bat maternity colony (USFWS 1999).

Tree roosts used by males are similar in characteristics to those used by maternity colonies. However, males will also use trees of smaller diameter or occupy caves during the summer (Harvey 1992; Romme et al 1995; USFWS 1999). In New Jersey, a male Indiana bat captured during the summer was documented to roost in a total of 6 different roost trees over a 13-day period. One primary roost tree, a red maple (*Acer rubrum*), and 5 secondary roost trees, 1 red maple, 2 gray birch (*Betula populifolia*), 1 yellow birch (*B. alleghaniensis*) and 1 green ash were identified. All roost trees used by this Indiana bat were dead snags with loose and exfoliating bark (Rinehart and Kunz 1998; Scherer 2000). White ash (*Fraxinus* ), red maple, American elm, and red oak were used as daytime roost sites in Pennsylvania (Hassinger and Butchkoski 2001). As in the previous study, all trees had exfoliating bark and six of the seven used were dead.

Foraging Habitat: Trees located within the floodplain and along streamsides are particularly important in providing areas in which to forage for insects. Open bodies of water, such as lakes and reservoirs, are also used as foraging areas. During the summer, females and juveniles forage in riparian and floodplain areas. Pregnant and lactating females also prefer open bodies of water and have been known to fly up to one and a half miles from upland roosts. In a Pennsylvania study, tagged Indiana bats foraged in pole stage deciduous forest with a moderate to dense shrub layer or in mature forest with a sparse shrub layer (Hassinger and Butchkoski 2001). This study also suggested preferential use of a lightly sloped, contiguous forest tract over smaller, fragmented patches. Foraging also occurs in the canopy of upland trees, over clearings with early successional vegetation, along the borders of cropland, along wooded fence-rows, and over pastures (Kurta et al. 1993; USFWS, 1999).

**Survey methodologies**:

The USFWS and the Indiana bat recovery team consider Indiana bats captured during the period of May 15 to August 15 to be summer residents (McKenzie pers. comm. in USFWS 2000). During the summer, netting locations should be chosen based on proximity to a travel corridor, the presence of water and the extent of closed canopy. Garner and Gardner (1992) recommend sampling on calm nights with no precipitation and a temperature of at least 50° F.

The fall swarming/foraging period begins in August and may extend into November depending on annual local weather conditions (USFWS 1999). Harp traps or mist netting at cave entrances is used during the fall, since bats tend to forage around the entrances to caves from late September to early October prior to hibernation. Unless in an area with a high amount of activity, the same site should not be sampled more than once, since bats have avoided nets on the second night. Radiotelemetry may also used in tracking movements and foraging ranges. Additional information on survey techniques and time frames may be obtained from the USFWS.

**United States Fish and Wildlife Service contact**:

Annette Scherer, U.S. Fish and Wildlife Service, New Jersey Field Office, 927 N. Main Street, Bldg D, Pleasantville, New Jersey 08232. (609) 646-9310 ex. 34.

**Regulatory Guidelines**

Area of Documentation: As noted above, the Landscape mapping designates all forested habitat contiguous with a 2 km (1.2 mile) radius from the hibernaculum as critical habitat. Recommendations received from the USFWS are that projects within 8.3 km (5 miles) of a hibernaculum have the potential to adversely affect habitats used by this species. As a result, the Department will establish a two-tiered protection strategy for the Indiana bat.

Principally, wetlands within 8.3 kms (5 miles) from the hibernaculum will be considered to be "documented habitat" that, if suitable, will warrant an exceptional resource value classification. This distance represents a conservative 5.8 km (3.5 mi) dispersal/ roosting radius from the over-wintering cave and an additional 2.5 km (1.5 mi) of foraging radius for adults and juveniles. Additional forested habitat identified on the Landscape mapping as Indiana bat habitat will be considered on a case by case basis for an exceptional resource value classification as our understanding of these animals habits and habitat use improves. Such habitats will, however, be subject to certain timing restrictions discussed in the "comments" section below.

Suitable Habitat: When assessing whether or not an area is suitable as Indiana bat habitat, it is necessary to examine the amount and quality of contiguous habitat, the percentage of canopy cover, the presence and quality of a stream/riparian habitat and the definition of the flight corridor. The following conditions are ideal in terms of foraging areas and roost sites. However, it is possible for suitable sites to not meet all of these criteria.

**1. Hibernacula**

*M. sodalis* prefers medium sized caves with large, shallow passageways or those whose configuration allows for the maintenance of a stable, cool microclimate necessary to allow hibernating bats to maintain a low metabolic rate and conserve fat reserves. During midwinter, ideal conditions inside caves include an average temperature of 37-43° Fahrenheit (Evans et. al. 1985) and a relative humidity of 74 percent (Barbour and Davis 1969; USFWS 1999).

**2. Roost sites**

Certain conditions must also be considered in determining which trees are appropriate roost sites. These include the species of tree, whether the tree is dead or alive, the quantity of loose or peeling bark, the amount of direct sunlight the tree receives and its proximity to other trees, water sources and foraging areas (USFWS 1999). Tree species include, but are not limited to, those identified above under the "Foraging and Roosting Habitat" discussion. Optimal densities of roost trees (>9 inches dbh) are 27 trees per acre in upland habitats and 17 trees per acre in floodplain habitats. However, lower densities of potential roost trees (Garner and Gardner 1992) or smaller diameter trees (Rommee et al. 1995) can also provide suitable habitat. Trees that face east-southeast and south-southwest are favored for maternity roosts because they receive adequate sunlight to warm maternity roosts, which is important for the development of young. Maternity roosts are generally close together (within a few meters of each other), although some are several kilometers apart. Additional criteria on the characteristics of suitable forest stands for roosting can be found in Garner and Gardner (1992).

**3. Foraging**

Overall, ideal summer foraging habitat is characterized by deciduous forest with at least 30% cover, with permanent water available within a 1.0-kilometer (0.63 mile) radius and suitable roost trees located within a 0.4-kilometer (0.25 mile) radius. However, deciduous forest with at least 5% cover can also provide suitable habitat and, as noted above, bats may also forage over early successional clearings, along the borders of croplands, along wooded fence-rows, and open pastures.

**Rationale:**

Since *M. sodalis* is known to make extensive use of floodplain and wetland forest for foraging and roosting and also to return to the same roost sites each year, preserving this habitat is critical to the species' survival (USFWS 1999). It is important to note that, due primarily to their age, individual roost trees are ephemeral in nature and there is a need to protect additional contiguous forest to maintain roost site longevity. Bats prefer mature forests with mostly closed canopies for primary roost sites and insect foraging. They also prefer trees that are close to intermittent streams. Identifying wetlands which feature suitable roosting or foraging habitat for this species as being of exceptional resource value will severe to protect critical wetland and adjacent upland habitat for the Indiana bat.

**Comments**:

The USFWS recommends a seasonal restriction of April 1 to November 15 during which the clearing of suitable upland or wetland forest roost or foraging habitat would be prohibited. For regulatory purposes, the Department will apply this condition to permited projects within all habitat blocks shown as Indiana bat habitat on the Department's Landscape maps. Noncontiguous forest fragments, forested areas with open canopies, open pastures and areas close to paved roads are not ideal as roost sites. However, while some studies have concluded that reproductively active females avoid paved roads (Garner and Gardner, 1992), other researchers have noted that distance to paved road is not a reliable parameter to measure the overall suitability of a habitat for the Indiana bat (USFWS 1999; MacGregor pers. comm. in USFWS 2000; McKenize pers. comm. in USFWS 2000). Still, because of the potential mortality resulting from bat /vehicle interactions, it is important to provide a buffer from highways and other paved roads. *M. sodalis* also uses areas of forest for alternate roost sites and riparian forest and stream corridors for travel and foraging. More research is needed to determine specific summer roost requirements of both males and females, migration and foraging habits and reasons for their decline.

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# SECTION 3

## FEDERAL LISTED PLANT SPECIES

**Name**: **Sensitive joint vetch (*Aeschynomene virginica*)**

**Status**: **Federal threatened species**
**State endangered species**.

**New Jersey Distribution:**

Historically, *A. virginica* was documented to occur in Atlantic, Burlington, Camden, Cape May and Salem Counties. Known extant sites now only occur along the Wading River in Burlington County and the Manumuskin River in Cumberland County

**Description:**

*A. virginica* is an annual legume which may reach the height of 1-2 m. (3.28-6.56 ft.). The plant typically features single stems which may branch near the top and long [2-12 cms.(0.8-4.8 in.)], gland-dotted leaves. Each leaf consists of 30-56 leaflets, which are between 0.8-2.5 cm (0.16-1 in.) long and 0.2-0.4 cm (0.08-0.16 in) wide (USFWS 1992b). Irregular, small flowers are yellow, streaked with red and grow in racemes. Flowering occurs in late July through September and fruiting occurs from July to first frost (USFWS 1992a).

**Suitable habitat:**

Throughout its range, *A. virginica* occurs across a gradient of fresh to brackish tidal river marshes. Plants generally occur within 2 m (6.5 ft.) of the low water mark on raised banks in peaty, sandy or

TABLE ONE: Plant associates of *Aeschynomene virginica*

| Scientific Name | Common Name |
|---|---|
| *Bidens laevis* | smooth begger's tick |
| *Leersia oryzoides* | rice cutgrass |
| *Petlandra virginica* | swamp lousewort |
| *Polygonum arifolium* | Halbeard-leaf tearthumb |
| *P. saggitatum* | arrow-leaf tearthumb |
| *Pontederia cordata* | pickerel weed |
| *Zizania aquatica* | annual wildrice |

(Bruderle and Davison 1984)

gravelly soils. Salinity at one New Jersey site ranged from 0.7-0.8 ppt with an average pH of 4.4 (Bruderle and Davison 1984). Table One lists species commonly associated with *A. virginica* locations. Seedling germination appears to be tied to bank and marsh flotsam which suppresses the establishment of more vigorous perennial species.

**Comments:**

Due to its association with tidal and brackish marshes, not all wetlands featuring *A. virginica* will fall under the jurisdiction of the Freshwater Wetlands Protection Act. It should also be noted that the species has also been identified in wet areas near agricultural fields and roadside ditches. Populations in these atypical habitats disappeared soon after their discovery (USFWS 1992a).

**Survey methodologies:**

No specific methodology has been recommended for *A. virginica* surveys.

**Office of Natural Lands Management Contact:**

Office of Natural Lands Management, Natural Heritage Database. (609) 984-1339.

**Regulatory Guidelines:**

1. Area of documentation: Wetland or wetland complex known to feature a documented occurrence of the species. This determination may include contiguous wetland habitat upstream and downstream of the documented population as well as freshwater wetlands adjacent to tidal or brackish water wetlands.

2. Suitable habitat: Suitable habitat for *A. virginica* consists of freshwater, brackish and tidal wetlands featuring a species composition consistent with or similar to the species identified in Table One.

**Comments:**

For each known location of *A. virginica*, the extent of wetland habitat designated for an exceptional resource value classification will vary due to site specific characteristics of the habitat present, including vegetational community, human or natural intrusions or disturbances, and the history, if available, of the species at that location. As a result, each wetland classification will be established on a case by case basis by the Department after an office and field evaluation of these characteristics. When feasible, the Department will attempt to reconfirm the presence of the specific plant species known historically (e.g. last observed > 20 years ago) from an area prior to establishing a regulatory designation.

**Rationale:**

*A. virginica* is currently known to occur at only two sites in New Jersey. While numbers of individuals may vary greatly between years, population locations remain fairly static. Threats to the species include shoreline stabilization projects, dredging, impoundment, road, commercial or residential development construction, and water withdrawal projects (USFWS 1992a). Sedimentation and reduced water quality may led to conditions which favor vigorous perennial species over *A. virginica* and lead to the displacement of the species from existing habitats.

Factors identified as critical to the preservation of local populations of this species include the protection of the habitat from direct impacts, maintenance of existing water quality and the establishment of sufficient upland buffer (Bruderle and Davison 1984). The designation of freshwater wetlands associated with documented populations of this species as being of exceptional resource value will provide additional protection from both direct and indirect impacts to *A. virginica* and establish 150 standard transition areas adjacent to these habitats to mitigate secondary impacts.

**Primary Author(s):**

Larry Torok, NJDEP, Land Use Regulation Progarm.

DRAFTDATE: 03/11/94 UPDATE: 07/07/95

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_____. 1992b. Sensitive joint-vetch (*Aeschynomene virginica*) Recovery Plan. Technical/Agency Draft. Hadley, MA. 51 pp.

**Name: Swamp pink (*Helonias bullata*)**

**Status: Federal threatened**
**State endangered**

**New Jersey Distribution:**

*Helonias* is documented to occur in Atlantic, Burlington, Camden, Cape May, Cumberland, Gloucester, Middlesex, Monmouth, Morris, Ocean, Salem and, historically, Mercer counties. The species is far more abundant in the southern Coastal Plain counties than in the north. New Jersey features in excess of 70% of the world's population of this species (L. Arroyo, pers. comm.).

**Description:**

*Helonias* is a smooth perennial herb with leaves which form a basal rosette. The leaves are evergreen, parallel-veined, and oblong, measuring between 9-25 cm (4-10 in) in length and 2-4 cm (0.8-1.6 in) in width. A single flower stalk appears in the spring (mid-late April) and features 30-50 pink flowers. During the winter months, the leaves of *Helonias* lie flat or slightly raised from the ground and are often obscured by leaf litter. Leaves often turn a reddish-brown color in the winter. New growth in the spring is generally bright green (C. Peterson in USFWS 1991).

**Suitable habitat:**

*Helonia*s may be found in a variety of habitats including:

1. swampy forested wetlands bordering meandering streams;
2. headwater wetlands;
3. sphagnous, hummocky, dense, Atlantic White cedar (*Chamaecyparis thyoides*) swamps;
4. bogs; and
5. spring seepage areas (USFWS 1991).

Soils throughout the species range are generally characterized as neutral to acidic. In North Carolina, Sutter (1982) described *Helonias* site soils as a thin layer of organic matter over black to dark gray silt loam featuring pHs between 4.2 and 4.9. Peterson (1990) found soil temperatures to differ little at the sites he studied. Other factors determined to be critical to the suitability of wetland habitat for *Helonias* include a stable hydrologic regime and canopy conditions.

Perhaps the most important factor affecting the occurrence of *Helonias* in a particular wetland is the hydrologic regime of the habitat. Rawinski and Cassin (1986) indicated that Helonias was restricted to groundwater influenced seepage swamps which are perennially saturated and rarely, if

ever, inundated by floodwaters. Sutter (1982) found the water table in these habitats is at or very near the surface and to fluctuate only slightly during spring and summer months. Habitats are also characterized by seeps and a lateral movement of groundwater (USFWS 1991).

TABLE ONE: Vegetative Associates of *Helonias bullata.*

| Scientific Name | Common Name |
|---|---|
| *Acer rubrum* | red maple |
| *Alnus serrulata* | red alder |
| *Aster puniceus* | purple-stemmed aster |
| *Aster radula* | rough-leaved aster |
| *Carex collinsii* | Collin's sedge |
| *Carex folliculata* | long sedge |
| *Carex muricata* | lesser prickly sedge |
| *Chamaecyparis thyoides* | Atlantic white cedar |
| *Clintonia borealis* | yellow clintonia |
| *Coptis trifolia* | gold thread |
| *Equisetum sylvaticum* | equisetum |
| *Ilex ambigua* | Carolina holly |
| *Ilex verticillata* | winterberry |
| *Kalmia latifolia* | mountain laurel |
| *Larix lariciana* | American larch |
| *Lindera benzoin* | spicebush |
| *Lycopus virgincus* | Virginia bugleweed |
| *Magnolia virginiana* | sweetbay magnolia |
| *Nyssa sylvatica* | black gum |
| *Orontium aquaticum* | golden club |
| *Osmunda cinnamomea* | cinnamon fern |
| *Picea mariana* | black spruce |
| *Picea rubens* | red spruce |
| *Pinus rigida* | pitch pine |
| *Pinus strobus* | white pine |
| *Rhododendron arborescens* | smooth azelea |
| *Rosa palustris* | swamp rose |
| *Sambucus canadensis* | elderberry |
| *Sphagnum spp*. | sphagnum moss |
| *Tsuga canadensis* | Eastern hemlock |
| *Viburnum cassinoides* | witherod |
| *Vaccinium constablei* | mountain blueberry |
| *Vaccinium corymbosum* | highbush blueberry |

USFWS (1991)

*Helonias* occurs in both deciduous and evergreen dominated wetlands. In New Jersey, the species is commonly associated with pitch pine (Pinus rigida), Atlantic white cedar, sour gum (*Nyssa sylvatica*) and red maple (*Acer rubrum*) forest (Johnson 1990; Peterson 1992). Other associated species include pepperbush (*Clethora alnifolia*), mountain laurel (*Kalmia latifolia*), sweetbay magnolia (*Magnolia virginiana*), American holly (*Ilex opaca*), golden club (*Orontium aquaticum*), long sedge (*Carex folliculata*), skunk cabbage (*Symplocarpus foetidus*), blueberry

(*Vaccinium* spp.), greenbriar (*Smilax rotundifolia*) and sphagnum moss (*Sphagnum* spp.). Two north Jersey sites feature black spruce (*Picea mariana*). A more detailed list of plant species associated with *Helonias* sites can be found in Table One.

Canopy structure may also play a significant role in the vitality of the species. In North Carolina, populations studied by Sutter (1982) occurred under canopy densities which varied from 20-100% closure. Populations in more open canopies appeared less vigorous due in part to competition with successional species, deer browse, and lower levels of seed set. Less conclusive evidence on the influence of canopy closure on the species was found by Peterson (1990; 1992) for the sites he studied in New Jersey.

**Survey methodology:**

Due to the evergreen characteristics of its leaves, *Helonias* can be identified during any time of the year. The species may be found by walking stream corridors and visually scanning hummocks outside the channel. Transacts through the wetlands may also be used for de novo survey work. Caution should be used during the winter, when leaf litter or snow cover may obscure prone rosette leaves, and also during the late spring and summer when vegetative growth, particularly skunk cabbage, may hide plants.

**Office of Natural Lands Management Contact**:

Office of Natural Lands Management, Natural Heritage Database. (609) 984-1339.

**Regulatory Guidelines:**

1. Area of documentation: Wetland or wetland complex known to feature a documented occurrence of the species. This determination will include contiguous wetland habitat upstream and downstream of the extent of the documented population.

2. Suitable habitat: Suitable habitat for *Helonias* consists not only of the wetland habitat actually occupied by the species, but also additional habitat necessary to preserve the subtle hydrologic regime and vegetative community structure characteristic of habitat occupied by the species. To this end, suitable habitat will also include:

a. the extent of contiguous downstream wetland habitat featuring a vegetative community of a species composition consistent with or similar to that described above; and

b. contiguous upstream wetland habitat to a distance sufficient to ensure that the existing hydrologic regime is maintained. This determination will be made on a case by case basis.

In situations where two or more distinct populations occur along a single stream corridor/wetland complex, the Department will consider the habitat in between the farthest upstream and downstream extent of the species as documented habitat. The criteria for suitability described above will be applied to the farthest upstream and downstream plants to ensure overall protection of the entire population.

**Comments:**

For each known location of *Helonias*, the extent of wetland habitat designated for an exceptional resource value classification will vary due to site specific characteristics of the habitat present, including vegetational community, human or natural intrusions or disturbances, and the history, if available, of the species at that location. When feasible, the Department will attempt to reconfirm the presence of the specific plant species known historically (e.g. last observed > 20 years ago) from an area prior to establishing a regulatory designation.

Also, due to the sensitivity of the headwater habitats where *Helonias* often occurs to perturbations of various forms, the Department generally discourages direct discharge of stormwater into *Helonias* habitats. In addition, the USFWS may request upland buffers of greater than 150 feet in situations where they believe the species may be adversely impacted by a particular development.

**Rationale:**

Various researchers have detailed the general changes to wetland communities in "developed" watersheds (Conner et al. 1981; Ehrenfeld 1983; Ehrenfeld and Schneider 1991). More specifically, Gordon (1989) described the cumulative impacts of soil erosion and the subsequent invasion of aggressive weed species on four historic New Jersey *Helonias* sites. Peterson (1990; 1992) indicated that populations in "impacted" sites featured fewer and smaller plants, higher levels of mortality, and lower levels of new seedlings when compared to populations in more "pristine" environments. Dobbs (1996) suggested that buffers a minimum of 31 meters (300 feet) may be required to minimize a variety of primary and secondary impacts resulting from upland development.

Based on these findings, effective long term protection of *Helonias* populations requires not only the protection of the immediate habitat around the plants, but also the wetland system in which they occur. The establishment of exceptional resource value wetlands (and their resultant 150 foot buffers) up and downstream of the population is necessary to:

a. ensure that suitable habitat for downstream expansion of the existing population remains available;

b. ensure that impacts to the vegetational community surrounding the plants are minimized;

c. ensure that modifications to the existing hydrologic regime of the wetland system are minimized; and

d. ensure that indirect impacts of development (e.g. sedimentation, dumping, alteration of hydrology, trampling etc.) upon the species and their habitat are minimized.

**Primary Author(s)**
Larry Torok, NJDEP, Land Use Regulation Program.

DRAFTDATE: 03/15/95 UPDATE: 06/24/02

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**Name**: **Small whorled pogonia (*Isotria medeoloides*)**

**Status: Federal threatened species**
**State endangered species**.

**New Jersey Distribution:**

Historically, *I. medeoloides* was known to occur in Bergen, Hunterdon, Passaic and Sussex counties in New Jersey. Currently, the species is only known to be extant in a few Sussex county locales.

**Description**:

The small whorled pogonia is a perennial herb standing between 3-30 cm (1.2-5 in.) in height. The stem is grayish-green with a thin waxy covering. A whorl of between 4-6 (usually five) leaves occurs near the top of the stem but below the flower. Leaves are generally grayish-green, slightly oblong and between 2.5-8.25 cm (1-3.5 in.) in length. Flowers are solitary or paired, greenish-yellow in color and about 1.75-2.5 cm (0.5-1 in.) in length. In New Jersey, stems emerge in late April or early May and flowering occurs in June

**Suitable habitat:**

Habitats occupied by *I. medeoloides* are generally described as dry-mesic to wet-mesic deciduous and occasionally evergreen forest featuring intermittent streams and acidic soils (Stewert 1978; Keenan 1988). Habitats found likely to feature *I. medeoloides* in New Hampshire and Maine were characterized by Rawinski (1986) as featuring:

1. Soil types, such as Skerry Very Stony Fine Sandy Loam, Millis Very Stony Fine Sandy Loam, which exhibit a fragipan that restricts downward movement of water;

2. Eastern facing slopes typically between 8-15%; and

3. A forested vegetational community.

Within these general habitats, two specific "microhabitats" appear to consistently support the species; the upper-most gullies which give rise to small intermittent streams and deposits of water-sorted leaf debris along "braided" channels of the streams.

Vegetative communities documented to feature I. medeoloides populations are usually described as "second growth" or successional forest. However, because numerous populations also occur in relatively mature communities, this may be more a reflection of the younger age of eastern forests than a factor influencing the reliance of the species on such forest communities (Rawinski 1986). A listing of species associated with *I. medeoloides* habitats is provided in Table One.

TABLE ONE: Vegetative Associates of Isotria medeolodies

| | |
|---|---|
| **Overstory** | |
| *Acer rubrum* | red maple |
| *Betula papyrifera* | paper birch |
| *Pinus strobus* | white pine |
| *Fagus grandifolia* | beech |
| *Populus grandidentata* | big-toothed aspen |
| *Quercus rubra* | red oak |
| *Tsuga canadensis* | eastern hemlock |
| **Understory** | |
| *Clethra alnifolia* | pepperbush |
| *Hamamelis virginiana* | witch hazel |
| **Gound cover** | |
| *Athyrium noveboracensis* | |
| *Dennstaedia punctilobula* | |
| *Lycopodium* spp. | clubmoss spp. |
| *Medeola virginianna* | indian cumcumber root |
| *Osmunda* spp. | ferns |

(Rawinski 1986)

Two sites in New Jersey are typified by second-growth mixed deciduous/coniferous forest over Swartswood gravelly loam, acidic soils (Radis 1987). Shared species include white pine (*Pinus strobus*), red maple (*Acer rubrum*), white oak (*Quercus alba*), ironwood (*Carpinus caroliniana*), and resprouting chestnut *(Castanea dentata*).

Other factors thought to affect the occurrence of *I. medeoloides* include vegetative density, light, and moisture. Mehroff (1980) suggested that dense cover may have been the result of some declines in small whorled pogonia populations. However, more recent research indicated that "(t)here seems to be no correlation ... between herbaceous cover and reproductive classs.... While it may be true that dense herbaceous cover could certainly limit the size of an *I. medeoloides,* in our study several blooming plants appeared in over 60% herbaceous cover."(Brumback and Fryler 1984). On the related topic of light, some researchers have suggested that increases light may affect plant vitality (D. Raynor pers. comm. in Rawinski 1986; W.E. Brumback pers. comm. in Rawinski 1986). Conversely, Rawinski (1986) believed that population size is largely dependent on the extent and quality of suitable soils rather than overstory density and basal area or light conditions. The influence of soil moisture on *I. medeoloides* is probably relatively minor though Homoya (1977) reported drought stress to cause premature dormancy in the species.

**Comments:**

*I. medeoloides* is listed as a facultative upland species on the National List of Plant Species which Occur in Wetlands for New Jersey (Reed 1988). Not all habitats featuring this species may meet the definition of a freshwater wetland.

**Survey methodologies:**

*I. medeoloides* may be identified by visually searching suitable habitats from late May into September. Searches may need to be conducted over a series of years to clearly establish the absence of the species. *I. medeoloides* plants have been documented to remain dormant for at least two years (W.E. Brumback pers. comm. in Rawinski 1986) and as much as 10-20 years (Correll 1950). Reported field observations appear to support a conclusion of shorter dormancy periods (Homoya 1977; Mehrhoff 1980; Brackley 1985). A survey conducted for a proposed gas pipeline in New Jersey consisted of the following steps:

1. initial reconnaissance of the ROW and 50 foot buffer;

2. characterization of the habitats present and their suitability for *I. medeoloides*; and

3. a survey of each habitat using transect methodology with the intensity of effort varying based on the level of suitability of the habitat for *I. medeoloides* (LEC 1994).

**Office of Natural Lands Management Contact**

Office of Natural Lands Management, Natural Heritage Database. (609) 984-1339.

**Regulatory Guidelines:**

1. Area of documentation: The area of documentation for *I. medeoloides* will be determined based on an assessment of the acreage supporting plants and additional surrounding habitat necessary to support wetland microclimate and hydrology. Larger habitat blocks will be considered in situations were several populations occur within a particular vegetative community. Due to the dormancy characteristic of *I. medeoloides*, historic sites will be considered "documented habitats" whether or not the species has been recently confirmed if the habitat remains suitable (see survey methodologies discussion).

2. Suitable habitat: Wetland habitats which feature a vegetation community largely composed of the species and characteristics described above will be considered as suitable habitat.

**Comments:**

For each known location of *I. medeoloides*, the extent of wetland habitat designated for an exceptional resource value classification will vary due to the site specific characteristics of the

habitat present, including vegetational community, human or natural intrusions or disturbances, and the history, if available, of the species at that location. As a result, each wetland classification will be established on a case by case basis by the Department after an office and field evaluation of these characteristics. When feasible, the Department will attempt to reconfirm the presence of the specific plant species known historically (e.g. last observed > 20 years ago) from an area.

**Rationale**:

Wetland habitats featuring *I. medeoloides* are typified by sloping topography and soils which create intermittent surfacewater drainage corridors. Ensuring the continuation of these conditions is critical to maintaining existing populations. Rawinski (1986) suggested preserve design should focus on protecting upslope habitats as well as adjacent buffer areas to preserve forest microclimate conditions. The designation of wetlands upslope and around known locales of *I. medeoloides* as being of exceptional resource value will serve both of these purposes.

**Primary Author(s):**

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DRAFTDATE: 01\10\95 UPDATE: 07\07\95

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**Name: Knieskern's beaked-rush (*Rhynchospora knieskernii*)**

**Status**: **Federal threatened**
**State endangered**

**New Jersey Distribution:**

In New Jersey, *R. knieskernii* is documented to occur in Ocean, Monmouth, Atlantic, Burlington and Camden counties. The state now represents the known global distribution of the species with the reported occurrences from Delaware believed to be extirpated (USFWS 1992)

**Description:**

*R. knieskernii* is a member of the sedge family (*Cyperacea*). The species is a grass-like annual or, occasionally a perennial. It grows from 1.5-60 cm (0.6-24 in) in height and is slender with short, narrowly linear leaves (USFWS 1991). Flowers occur in small clusters and are numerous. Fruiting occurs from July to October, persisting into the winter months.

**Suitable habitat:**

*R. knieskernii* is an obligate hydrophyte which occurs in groundwater-influenced, largely successional habitats that are either natural or man-induced. Natural habitats are usually characterized as wet bog-iron sites often adjacent to slow-moving streams (see Boyd 1991 for additional details). Such sites are often found in pitch pine (*Pinus rigida*) lowland swales and pine barrens savannahs (USFWS 1992). Vegetative succession in these sites is probably suppressed by the low productivity of the soils, heavy duff mat, and incidents of fire. Water regimes are moist to wet and fluctuate from season to season (Schuyler no date).

Other sites featuring *R. knieskernii* occur in areas where actions related to human disturbance maintain early successional communities. Such sites include abandoned clay pits and borrow pits which hold water in ephemeral ponds, ditches, unimproved roads, power line and railroad right-of-ways. Fluctuations in the environmental conditions maintaining these habitats (i.e. rainfall, levels of human disturbance, competing species) make the long term suitability of these sites suspect without management. Plant species found in association with *R. knieskernii* are listed in Table One.

**Survey methodology**:

Visual surveys of potential habitats by biologist experienced in the *Rhynchospora* genus during the peak fruiting period of August through October has been suggested (pers. comm D. Peters).

**Office of Natural Lands Management Contact:**

Office of Natural Lands Management, Natural Heritage Database. (609) 984-1339.

**Regulatory Guidelines:**

1. Area of documentation: Wetland or wetland complex known to feature a documented occurrence of the species or which is required for its continued existence.

2. Suitable habitat: Suitable habitat for *R. knieskernii* consists of bog-iron seeps and early successional wet areas featuring a vegetative community composed of a species composition similiar to that found in Table One.

**Comments:**

For each known location of *R. knieskernii*, the extent of wetland habitat designated for an exceptional resource value classification will vary due to site specific characteristics of the habitat present, including vegetational community, human or natural intrusions or disturbances, and the history, if available, of the species at that location. As a result, each wetland classification will be established on a case by case basis by the Department after an office and field evaluation of these characteristics. When feasible, the Department will attempt to

TABLE ONE: Vegetative Associates of *Rhynchospora knieskernii*

| | |
|---|---|
| *Aristida longespica* | Three-awned grass |
| *A. virgata* | wand-like threee awned grass |
| *Calamovilfa brevipilis* | pine barren reedgrass |
| *Cyperus dentatus* | flatsedge |
| *Drosera intermedia* | sundew |
| *Gentiana autumnalis* | pine barren gentian |
| *Eupatorium leucolepis* | bonset |
| *Hypericum canadense* | St. John's wart |
| *Juncus caesariensis* | New Jersey rush |
| *Lobelia nuttallii* | Nuttall's lobelia |
| *Lycopodium carolinianum* | slender clubmoss |
| *Muhlenbergia torreyana* | pine barren smoke grass |
| M*uhlenbergia uniflora* | smoke grass |
| N*arthecium americanum* | bog asphodel |
| *Rhexia virginica* | meadow beauty |
| *Rhynchospora capitellata* | beaked-rush |
| *Rhynchospora chalarocephala* | beaked-rush |
| *Rhynchospora pallida* | pale beaked-rush |
| *Schizaea pusilla* | curly grass fern |
| *Scleria minor* | slender nut rush |
| *Scleria reticularis var. pubescens* | nut rush |
| *Vaccinium macrocarpon* | cranberry |

(USFWS 1992)

reconfirm the presence of the specific plant species known historically (e.g. last observed > 20 years ago) from an area prior to establishing a regulatory designation. Due to the requirement of early successional habitats by *R. knieskernii*, management agreements with landowners may be an effective mitigation tool for minimizing impacts resulting from permittable activities in surrounding wetlands and/or transition areas. Kolaga and Schuyler (1993) suggested that techniques such as shade tree cutting, turf removal, or controlled burn can be beneficial for *R. knieskernii*.

**Rationale:**

The global population of Knieskern's beaked-rush is represented by approximately 30 sites in freshwater wetlands in New Jersey. Due to the early successional nature of these habitats, they are threatened by hydrological changes, native and introduced vegetative species succession, and various human related activities (e.g. dumping, dirt biking, trampling). The identification of these wetlands as being of exceptional resource value prevents direct impacts from affecting the species. The imposition of a wetlands buffer mitigates for alterations of hydrology, the invasion of more aggressive plant species, and various human related impacts. Such actions are consistent with preserve designs developed by Kolaga and Schuyler (1993) which included additional buffer areas of wetlands and uplands to ensure long term protection of local populations of this species.

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# APPENDIX 1

SPECIES FOR WHICH SPECIFIC CRITICAL AREA MODELS WERE DEVELOPED FOR THE LANDSCAPE MAPPING

## BALD EAGLE

Nest Sites: A 1-km radius around each active bald eagle nest is designated as critical habitat in order to protect it from disturbance. All appropriate habitat patches that intersect with this buffer are designated as critical.

Foraging Areas: All known bald eagle nests are recorded using GPS equipment. To run the model, all water polygons from the NJDEP LU/LC having an area greater than 8 hectares are converted to a 5-meter grid. A radius around the nest site is incrementally increased, one cell (5 meters) at a time, until an area of 660 hectares of open water has been identified. All emergent wetland patches within 90 meters of the identified water are selected. The emergent wetland patches are merged with the identified open water. A 90-meter buffer is applied to the combined water/emergent wetland layer to protect perching sites. In the previous version (1.0) all habitat patches that intersected with the foraging habitat and 90-meter buffer were designated as critical areas. In Version 2.0, bald eagle foraging habitat, and its associated 90-meter buffer, is no longer used to value patches that intersect with it. The bald eagle foraging model is a stand-alone GIS layer that is not used to value habitat patches.

## TIMBER RATTLESNAKE

**Skylands Landscape:** Hand-digitized polygons that represent timber rattlesnake den locations and their associated foraging areas. This is adequate in protecting the majority of female gestating and birthing areas, transient habitat, and foraging habitat. Most gestating and birthing areas in this part of the state occur within a few to several hundred meters of the den location.
**Pinelands and Delaware Bay Landscapes:** Any portion of a stream (including intermittent) within 2.5 km of a timber rattlesnake occurrence (seconds precision only) is considered “potential hibernacula.” The identified stream segments are buffered 1 km.

## BOG TURTLE

Critical areas for bog turtles are mapped by hand-selecting emergent, scrub/shrub, modified agricultural and forested wetland polygons from the DEP Freshwater Wetlands maps. The selected wetland habitats correspond to core bog turtle habitat (i.e. where turtles are concentrated), contiguous dispersal corridors between extant colonies within 1.8km (1 mile) of each other, and groundwater discharge areas, where possible. Only extant populations were mapped. Suitable bog turtle habitat that is not connected to an extant site is not incorporated into the mapping.

## WOOD TURTLE

Critical areas for wood turtles are mapped following a four-step process. A 1.6-kilometer radius is placed around each wood turtle sighting location in the BCD. A 322-meter buffer is then applied to all streams that fall within the 1.6-kilometer radius. The NJDEP LU/LC is then overlaid on the buffered areas and all areas classified as urban, with the exception of powerline rights-of-way, are deleted from the buffer. NJDEP Freshwater Wetland Maps are overlaid on the stream buffers, and all wetlands that intersect the buffer are clipped within the 1.6-kilometer radius and are merged into the stream/buffer polygon. The final step of the process involves a detailed quality control check and revision of each polygon to ensure biological accuracy. The wood turtle model is a stand-alone layer that is not used to value habitat patches.

The two principle differences between Version 1.0 and 2.0 are as follows: In Version 2.0, streams classified as 1st order or greater are included, while in Version 1.0 only streams classified by NJDEP as 2nd order and greater were included. This change was made based upon additional analysis following release of Version 1.0 that revealed a large number of documented wood turtle occurrences were on NJDEP 1st order streams, which were suitable for wood turtles.

In Version 2.0, only the identified wetlands together with the streams and stream buffers constitute wood turtle habitat, while in Version 1.0 any patches of upland forest, forested wetland, emergent wetland and grassland that intersected with the wetland and stream buffers were valued as wood turtle habitat. This change was made to limit the delineated habitat to those areas closest to suitable streams because the approach used in Version 1.0, included areas too distant from streams to be considered suitable for wood turtles. As a result of applying both of these changes, Version 2.0 values significantly less area as wood turtle habitat than Version 1.0.

## INDIANA BAT

A 2 km radius is placed around all known hibernacula to protect the integrity of the forests around the portal. All suitable habitat patches that intersect with this buffer are designated as critical.

## COLONIAL NESTING WATERBIRDS

Terns and Skimmers: Nesting area critical habitat includes all open water, beaches, mudflats and emergent wetlands within the foraging radius from a known nesting colony. Foraging radii:

| | | | |
|---|---|---|---|
| black skimmer | 6.5 miles | Forster's tern | 7.5 miles |
| least tern | 3.0 miles | common tern | 7.5 miles |

Herons and Egrets: Critical nesting habitat includes all undeveloped habitat within 90 meters (3 pixels) of a known nesting colony, 180 meters for great blue heron. Critical foraging habitat includes all emergent wetlands, all tidal creeks and ditches, and all open waters within 90 meters of the shoreline within the foraging radius of a known nesting colony. Foraging radii:

| | | | |
|---|---|---|---|
| great egret | 7.1 miles | tri-colored heron | 6.5 miles |
| snowy egret | 8.6 miles | black-crowned night heron | 6.0 miles |
| cattle egret | 7.0 miles | yellow-crowned night heron | 1.7 miles |
| great blue heron | 7.5 miles | glossy ibis | 9.1 miles |
| little blue hereon | 8.2 miles | | |

**PIPING PLOVER**

All barrier island beach habitat 90 meters on each side of known nesting areas extending from the ocean/sand interface to the first development beyond the upper dune.

**PEREGRINE FALCON**

In Version 1.0 of the Landscape Project, emergent wetland patches that intersected a1-kilometer radius area delineated around a peregrine falcon nest were valued as peregrine falcon habitat.

In Version 2.0, peregrine falcon nests are separated into two types, urban and non-urban depending on the type of landscape in which they are located. For urban nests a 1-kilometer radius area around the nest is now valued as peregrine falcon habitat regardless of the land-cover type. Urban peregrine nests continue to value emergent wetland patches that intersect with the 1-kilometer radius area delineated around a peregrine falcon nest. Non-urban peregrine falcon nests continue to value only emergent wetland patches that intersect with the 1-kilometer radius area around the nest. The urban peregrine falcon model is a stand-alone GIS layer that values emergent wetland habitat patches.

**NORTHEAST BEACH TIGER BEETLE**

All barrier beach habitat 90 meters on each side of a known colony extending from the low to mid tidal zone to the upper dune.

**MIGRRATORY RAPTOR CONCENTRATION SITE**

All non-developed habitat (1995 CRSSA LC) in the lower 10 kilometers of the Cape May peninsula.

**MIGRATORY SHOREBIRD CONCENTRATION SITE**

ENSP staff hand-digitized polygons that represent sites where migratory shoregbirds congregate for feeding or staging during migration.

## BARRED OWL, RED-SHOULDERED HAWK AND BOBCAT

Since these species require large, unfragmented patches of forest they only value those patches that meet the core area requirements as defined in the “Detailed Methodology for Delineating Critical Areas by Habitat Type” section of this document.

## APPENDIX II: Selected home range data for endangered or threatened species

### Blue-spotted salamander/tiger salamander

**TABLE ONE**: Summary of dispersal movements and home range sizes for various *Ambystoma* species.

| Location | Home Range | Distance | Source |
|---|---|---|---|
| New York | | 111 meters (364 ft) | Madison in Clark 1990! |
| South Carolina | 0.12-7.6 meters (0.5-25 ft) | 162 meters (531 ft) | Semlitsch 1983! |
| South Carolina | 0.02-23 m(2) (0.1-75 ft) | 81-261 meters (265-856 ft) | Semlitsch 1981* |
| South Carolina | | 12-67 meters (40-220 ft) | Semlitsch 1981$ |
| ? | | 150 m (aver.) (492 ft) | Douglas and Monroe 1981# |
| ? | | 250 m (aver.) (820 ft) | Douglas and Monroe 1981@ |
| Indiana | | 195 m (aver.) (640 ft) | Williams 1973^ |
| Missouri | | 172 m (max) (564 ft) | Sexton et al. 1986^ |
| Tennessee | | 600 m+ (1968 ft) | Biedermann 1988! |

* mole salamander (*Ambystoma talpoideum*)
$ juvenile mole salamander
# spotted salamander (*Ambystoma maculatum*)
@ Jefferson's salamander (*Ambystoma jeffersonianum*)
^ marbled salamander (*Ambystoma opacum*)
! tiger salamander (*Ambystoma tigrinum tigrinum*)

Home range/movements: While home range data is lacking for blue-spotted salamanders, various studies on other *Ambystoma* have identified movement patterns. A summary of *Ambystoma* species dispersal movements and home range sizes is provided below in

Table One. These home range figures address habitat use after a post-breeding dispersal from the breeding pond. The great distance moved by the tiger salamander population in Tennessee studied by Biedermann (1988) may be the result of the breeding pond being surrounded by cultivated fields. Blue spotted salamanders have been observed in excess of 30 meters (98.4 feet) from suitable breeding ponds in Troy Meadows (L. Torok, pers. comm.).

**Bog Turtle**

Home Range/Movements: A summary of bog turtle home range/ movement data is provide below in Table One. It must be noted that these data are based on limited sample sizes and various techniques. As a result, while they do provide some measure of the minimum habitat requirements for the species, they can not be used as definitive representations of spatial habitat requirements. Within these home ranges, turtles will use both upland and wetland areas. In Delaware, Arndt (1977) recorded bog turtles in meadows, dead on the road, and in ferns and brush bordering meadows. Zappalorti and Zanelli (1978) reported a small percentage of the bog turtles they found crossing dry land. In Maryland, Chase et al. (1989) never encountered turtles outside of the wetland transition zone, however, they also indicated that "...the substrate may range from wet to dry pockets...Some areas may be seasonally or intermittently flooded" (pg. 359).

**TABLE TWO:** Home range estimates for the bog turtle

| Location | Home Range | Source |
|---|---|---|
| Pennsylvania | mean 1.33 ha#<br>3.32 ac.<br>mean 1.28 ha@<br>3.2 ac. | Ernst 1977 |
| Pennsylvania | max. 0.121ha#<br>0.302 ac.<br>max. 0.943ha@<br>2.36 ac. | Barton 1957 |
| Maryland | max. 0.24ha#<br>0.6 ac.<br>max. 0.086ha@<br>0.22 ac. | Chase et al. 1989 |
| New York | 2-3 ha (5-6.5 ac.) | Breisch 1986<br>1986 |

# = males @ = females

It has also been suggested that, due to the successional nature of bog turtle habitat, conservation efforts should focus on maintaining wetland networks to allow movement and gene flow between otherwise disjunct populations and/or emmigration into areas of suitable habitat from degrading habitats (Kiviat 1978; Chase et al. 1989). Linear distances travelled by bog turtles include 200 m (656 ft) and 225 m (738 ft). One pair of bog turtles studied in New York moved between 750 and 850 m (2460-2788 ft) from one meadow to another meadow (A. Breisch, pers. comm.). Habitats transversed included a red maple swamp and a beaver dam.

**Wood Turtle**

**TABLE THREE**: Summary of wood turtle home range/movement data.

| Location | Home Range | Distance | Source |
|---|---|---|---|
| New York | #30-50m<br>98-164 ft | *1300-3250m<br>4264-10,660ft | Carroll and Ehrenfeld 1978 |
| Pennsylvania | 214-680m<br>703-2230ft | | Stang 1983 |
| " | | "hundreds of meters." | Kaufmann 1992 |
| New Jersey | | 915-1610m<br>3000-5280ft | Zappalorti 1984 |
| New York | 1.81 ha (aver)<br>4.52 acres<br>.03 ha (max)<br>.10 acres | 700 m (max.)<br>2296 ft. | Burt and Collins, no date |
| Michigan and New Jersey | | 800m(max)<br>2625ft | Harding and Bloomer 1979 |
| Canada | 24.3 ha (aver)<br>60 acres<br>115 ha (max)<br>284 acres | | Quinn and Tate 1991 |

# resident turtles *displaced turtles

Home range/ movements: In addition to the data provided above, wood turtle movements away from the breeding/wintering stream habitats have been shown to be highly variable. Several studies have determined that most non-aquatic wood turtle activities occur within 30 (98 feet) to

40 meters (130 feet) of the home stream (Brewster and Brewster 1991; Quinn and Tate 1991). Others have reported wood turtles moving upland as far as 100-400 meters (340-1312 feet) (Ernst 1986).

**Timber rattlesnake**

Home Range/Movements: Movement data obtained from radio telemetry work in the New Jersey Pine Barrens established male activity ranges averaged 124 ha. (306 ac.), while females averaged 14 ha. (35 acres). The largest range documented was 150 ha. (370 acres) (Zappalorti and Reinhart 1986). In New York, maximum dispersal distances were 2.8 kms (1.7 mi.) for males, 2.5 km (1.5 mi.) for females. Gravid females remained within 400 meters (1300 ft.) of the den (Brown and MacLean 1983). R. Stechert (pers comm) reported male rattlesnakes moved an average linear distance of 3.3 km (2 mi), with non-gravid females moving up to 2.5 km (1.5 mi). Maximum recorded movement of gravid females was 1.8 km (1 mi).

Home Range/Movements: No home range reported. Anderson and Martino (1966) report finding adult salamanders as much as 30 meters (98 feet) from water in the early spring. By late May most salamanders occurred along the water's edge, generally within 6.1 meters (20 feet).

## Pine Barrens treefrog

Home Range/Movements: Freda and Morin (1984) and Freda and Gonzalez (1986) detailed the movements of radio-isotoped treefrogs in New Jersey. Tagged frogs generally remained within 70 meters (230 ft) of their breeding pond. One tagged frog was located 102 meters (335 ft) from the pond with others frequently heard in excess of 100 meters (328 ft) from ponds during survey work.

Treefrog breeding populations are also dynamic within contiguous wetland complexes. The suitability of individual breeding sites from one year to the next is often a factor of annual rainfall, rate of vegetative succession, and period of wildfire occurrence (Freda and Morin 1984). Zappalorti (pers. comm.) has indicated that breeding populations have appeared to colonize suitable habitats up to 0.85 kilometers (0.5 miles) from previously documented habitats during years when these habitats were not suitable. On-going studies at the Ocean County Community College wetland complex have demonstrated that breeding colonies may move throughout a wetland complex to colonize suitable breeding ponds (Connell 1991).

**Southern Gray treefrog**

Home Range/Movements: Little information exists concerning southern gray treefrog home range. R.T. Zappalorti (pers. comm.) recorded a southern gray treefrog calling 75 meters (240 ft) from a confirmed breeding pond in Cape May. In Tennessee, male treefrogs moved linear distances of up to 0.43 kilometers (0.25 mi) and one female moved 0.63 kilometers (0.4 mi) between breeding ponds (Ritke et al. 1991). All sites were connected by natural stands of

hardwood vegetation. Pine barrens treefrogs (Hyla andersonii) have been documented to disperse in excess of 100 meters (328 ft) from their breeding pond (Freda and Gonzalez 1986).

**Henslow's sparrow**

Home range/movements: Information of the spatial requirements for Henslow's sparrow revolve around territory size and minimum habitat requirements. Defended territories documented include an average of 0.3 ha (0.8 ac.) in Michigan and 0.6 ha (1.5 ac) in Wisconsin (Robins 1971; Wiens 1969). Maximum territory sizes identified were 1.04 ha (2.6 ac.) and 1.08 ha. (2.7 ac.) respectively. It should be noted that territory size is susceptible to seasonal and prey-base fluctuationss. It has also been suggested that Henslow's sparrow is an area dependent species requiring fields between 10-100 ha. (25-250 ac.) in size to support viable populations (Samson 1980). Studies in Illinois found the species only to occur in fields > 40 ha. (100 ac.) in size (J. Herkert 1994).

**Short-eared owl**

Home Range/Movements: A summary of home range/territory data for the short-eared owl is provided in Table One. Based on these data, Tate (1992) suggested that areas a minimum of 50 ha (125 ac) of low, open grasslands or similar habitat which featured abundant rodent populations warranted protection. It must be noted that the data provided above is based on diurnal activity and it has been suggested that nocturnal foraging may be more extensive (K.P. Combs in Tate 1992).

**TABLE FOUR**: Summary of short-eared owl winter and summer home ranges.

| Location | Size | Source |
|---|---|---|
| Massachusetts | 51 ha. (25-98 ha.)<br>127.5 ac. (62.5-245 ac) | Holt and Melvin 1986; Tate and Melvin 1987, 1988; Combs and Melvin 1989 |
| Scotland | 18-156 ha | Lockie 1955 |
| Manitoba, Canada | 73.9 ha. (mean)<br>184.75 ac.<br>121.4 ha. (max)<br>303.5 ac. | Clark 1975 |
| Scotland | 85 ha. (25-242 ha.)*<br>212.5 ac (62.5-605 ac)<br>42-72 ha#<br>105-180 ac. | Village 1987 |

* summer territory # winter territory

**Red-shouldered hawk**

**TABLE FIVE:** Home range data for the red shouldered hawk.

| Location | Home range | Source |
|---|---|---|
| Kansas | 72 ha. (180 ac.) | Fitch 1958 |
| Michigan | | |
| 1942 (aver.) | 42 ha. (130 ac.) | Craighead and |
| (max.) | 107 ha. (269 ac.) | Craighead 1956 |
| 1948 (aver.) | 48 ha. (188 ac.) | |
| (max.) | 154 ha. (384 ac.) | |
| Missouri | 108.9-127.6 ha.<br>272-319 ac. | Parker 1986 |
| Maryland | 399/434 ha.*<br>997/1085 ac. | Senchak 1991 |
| | 224/ 238 ha.@<br>560/595 ac. | |

* male breeding/post-breeding
@ female breeding/post-breeding

Home range/movement data: A summary of red-shouldered hawk home range data is provided in Table One. There are two points of significance concerning these data. First, it must be noted that there is a general lack of home range data for this species. Much of the data available discusses nesting pair densities and spatial separation within contiguous habitats. Various nesting densities reported include 1 pair/48.7 ha (121.75 ac) in Maryland; 1 pair/171 ha. (427.5 ac.) in New York; 1 pair/645 ha. (1613 ac.) in Michigan and 1 pair/360 ha (900 ac.) in New Jersey. (Stewert 1949; Crocoll and Parker 1989; Craighead and Craighead 1956; Bosakowski et al. 1991). Based on their data, Bosakowski et al. (1991) suggested a minimum "home range" of a 0.8 km radius around red-shouldered hawk nests. Secondly, the data collected by Senchak (1991) indicated an increase in home range size during the post-breeding season. Her findings support more casual observations made by other researchers (Craighead and Craighead 1956; R. Radis pers comm.).

**Northern Harrier**

Home Range/Movements: Evidence on northern harrier home range or hunting ranges is generally sparse. However, indications are that the species will forage over a large area during the breeding season. It is important to note, the availability of prey will greatly affect the amount

**TABLE SIX:** Hunting ranges for the northern harrier.

| Location | Range (sq. km/sq. mi) | Reference |
|---|---|---|
| Europe | 1.8-4.1 / 0.69-1.57*<br>< 1.0 / 0.38# | Terschelling in Schipper 1977 |
| Europe | 7.2-12.3 / 2.77-4.73*<br>0.8-5.4 / 0.31-2.07# | Flevoland in Schipper 1977 |
| Minnesota | 2.6 / 1# | Breckenridge 1935 |
| Idaho | 9.7-17.7 / 3.73-6.8*<br>1.1 / 2.86 # | Martin 1987 |
| Mass. | 1.4-4.2 / 0.54-1.61# | Serrentino 1987 |

* males # females

of habitat the species will use. In Wisconsin, Hamerstrom et al. (1985) documented the relationship between vole populations and polygamous behavior in the harrier population they studied. Craighead and Craighead (1956) identified "seasonal hawk ranges" for breeding raptors in Michigan. Their harrier data indicated an average range of 5.87 sq. km (2.26 sq. mi) in 1942 and 2.08 sq. km (0.80 sq. mi) in 1948. Hecht (1951) reported the species to defend an area with a 99 m. (975 ft.) radius around nests in Canada. Northern harriers will also defend "territories" during the winter. However, such areas are generally only used for hours or days (Bildstein and Collopy 1985).

**Sedge Wren**

Home Range/Movements: No data is available on home range size for sedge wrens. Males defended territories an average of 1280 sq. meters (4198 sq. feet) in Minnesota (Burns 1982).

**Bald Eagle**

Home Range/Movements: Little information exists which clearly defines home range or movement patterns of breeding eagles. Frenzel (1983) reported home ranges of an average of 660 ha. (1650 ac.)[range 325-1384 ha (813-3460 ac)] for eight pairs of eagles studies in Oregon. Haywood and Ohmart (1983) reported home ranges of 64 km(2) [38.4 mi(2)] in Arizona. Instead, most studies have investigated the relationship between disturbance factors and the distance from nesting or perching birds where these factors affect their behavior. In Canada, Leighton et al (1979) established eagle breeding areas as a 0.8 km (0.48 mi) radius around the nest and assumed that adult eagles observed within 1.6 km (0.96 mi) of a nest constituted a breeding pair. In their nesting habitat

model for Maine, Livingston et al. (1990) defined the "nest area" as a 500 m (1640 ft) radius around the nest site and established the foraging area at a radius of 1.5 km (0.9 mi). Anthony and Isaac (1989) also defined the area within 1.6 km (0.96 mi) of the nest as breeding habitat in their research in Oregon.

Other studies have focused on the effects of various activities and their impacts on eagle behavior. Anthony and Isaacs (1989) suggested variable buffers of 400 m (1312 ft) for roads, trails and boat launches to 800 m (2624 ft) for human activities. In Florida, Wood et al. (1989) proposed a primary zone of 229 m (751 ft) for human disturbance and secondary zone from 229-457 m (1499 ft) for tree cutting be established during the breeding season where activities were prohibited.

In regard to the flushing of perched birds, various studies have analyzed the responses of eagles to various levels of disturbance. Factors influencing flush distance include type of disturbance, quality of habitat, quality of prey base, and eagle activity at time of the disturbance. In general, flushing responses of eagles to human disturbance (i.e. walking, shouting) have varied from 20 m (66 ft) to 540 m (1771 ft) (Stalmaster 1976; Nye 1977; Stalmaster and Newman 1978; Wallin and Byrd 1984). Flush responses to boat traffic varied from 40-400 m (131-1312 ft) with slow moving crafts at the low end and faster, less consistent traffic toward the high (Jones 1973; Knight and Knight 1984; Wallin and Byrd 1984)

**Pied-billed Grebe**

Home Range/Movements: Little information on the home range or territory requirements of pied-billed grebes is available. Glover (1953) reported that grebes defended an area within approximately 46 m. (150 ft.) of the nest and postulated that the species home range was usually about twice this size.

Another indicator of pied-billed grebe spacial habitat requirements are the size of breeding wetlands and/or density of nesting pairs. Sealy (1978) reported only one pair of grebes per pothole in Manitoba. Chabreck (1963) reported 1 nest/ 0.75ha (1 nest/ 1.8 ac.) in Louisiana. Faaborg (1976) reported an average of one pair per 2.2 ha (1/5.5 ac.) in wetlands studied in North Dakota. No grebes were identified in ponds less than 0.6 ha (1.5 ac.) in this study. The impoundment studied by Forbes et al. in Nova Scotia featured densities of 1 nest/1.25 ha (1 nest/3.1 ac.) in 1982 and 1 nest/0.56 ha (1 nest/1.4 ac.) in 1983. Brown and Dinsmore (1986) found grebes to occur in five size classes of wetland ranging from < 1 ha. (2.5 ac.) to > 20 ha. (50 ac.). A significant increase in the frequency of occurrence of pied-billed grebes in wetland complexes > 5 ha (12.5 ac) led them to classify the species as an area dependent. Studies in Maine found grebes only to occur in wetlands > 5 ha (12.5 ac) in size (Gibbs and Melvin 1990; Gibbs et al. 1991)

**Long-eared owl**

Home range/territory size: In both the study done by Wijnandts (1984) in the Netherlands and Craig et al (1988) in Idaho, the areas used by long-eared owls were variable. In Idaho, breeding owl home ranges increased in size soon after the hatching of

**TABLE SEVEN**: Summary of long-eared owl home range data

| Location | Size (ha/ac) | Reference |
|---|---|---|
| Idaho | 61.8 (40.6-83) ha^<br>154.5 (101.5-207)ac<br>144.3 (131.1-157.5)ha*<br>360 (327.8-393.7)ac | Craig et al. 1988 |
| Wyoming | approx 55 ha (137 ac) | Craighead and Craighead 1956 |
| Netherlands | aver. 2025 ha (5062 ac)<br>range 1136-2560 ha<br>2840-6400 ac | Wijnandts 1984 |

^ females/incubating-hatching * 12 days after hatching

the young. Male owls in this study often utilized areas outside the 3 km radio range so a true indication of home range could not be established. In the Netherlands, the large home ranges for over-wintering owls were further analized to reveal that 90% of owl activity took place in between 22-31% of the owls home ranges. In spacial terms, owl activity was largely concentrated in areas between 350-700 ha (875-1750 ac) in size. Roosting site distant, which averaged 5.5 km (3.3 mi) from favored feeding areas accounted for much of the additional acreage included in owl home ranges.

## American bittern

Home Range/Movements: Limited information exists on the spacial habitat requirements of the American bittern. Sample nesting densities include; five nests in 0.25 square miles, two nests on five acres, five nests on 160 ha. (402 acres), five nests on 64.8 ha.(168 acres), and two nests on two hectares (five acres) (Bent 1929; Vesall 1940; Palmer 1962). Bitterns in Maine inhabitated wetlands ranging from < 1 to > 25 ha in size but were more abundant in larger wetland complexes (Gibbs et al. 1991). Conversely, a study conducted in Iowa by Brown and Dinsmore (1986) did not find bitterns in marshes less than 11 ha. (27.5 ac.) in size and they suggested that the species is area dependent.

## Bobolink

Home range/territory size: Limited data on territory size for bobolinks exists. In Wisconsin, territories ranged from 1.1-4.9 ha (2.7-12.1 ac.) and averaged 2.6 ha (6.5 ac.)(Weins 1969). Whittenberger (1980) established territories of 0.74 ha (1.8 ac) in quality habitats and 1.45 ha (3.6 ac) in poor habitat.

Another indicator of the spatial requirements of the bobolink is the size of occupied suitable field habitats. Study areas in New York were between 19-22 ha (47.5 - 55 ac) in

size (Bollinger and Gavin 1989). Whittenberger's study site in Oregon as 27.3 ha (68.25 ac) in size. Weins (1969) Wisconsin site was 32.4 ha (80 ac) in size. No data is available on minimum habitat size to support breeding bobolinks.

## Black Rail

Home range/territory size: Little information occurs in regard to the amount of habitat used and/or required by black rails. Studies in freshwater habitat in Arizona identified home ranges of an average of 0.43 ha (1.7 ac) with a core use are of 0.1 ha (0.25 ac) (R. Flores in Davidson 1992). Estimated territory sizes in contiguous salt marsh habitats encompasses 3-4 ha (7.5-10 ac)(J.S. Weske in Davidson 1992). Repking and Ohmart (1977) observed most activity to occur within an average of 23 m (75 ft) of unvegetated edge (e.g. open water, roadway) and to be concentrated within a 0-4 m (0-13 ft) perimeter of the marsh. Kerlinger and Sutton (1988) suggested that black rail breeding colonies may be ephemeral or "nomadic" and that large expanses of suitable habitat may be necessary to support healthy populations.

## Red-headed Woodpecker

Home range/habitat size reguirements: Little is known about the home range requirements for the red-headed woodpecker. Documented densities of nesting pairs may provide the best indicator of the species spacial requirements. Graber et al. (1977) recorded 9-12 birds per 40 ha (100 ac) in their Illinois bottomwood forest site. Twenty-eight birds were documented in a 40 ha (100 ac) shrub area also in Illinois (Graber and Graber 1963). Woodlots used for nesting in Virginia varied in size from .5-20 ha (1.2-50 acres)(Connor 1976).

### Osprey

**TABLE EIGHT**: Distances traveled by osprey between the nest and foraging habitats.

| Location | Distance travelled | Reference |
|---|---|---|
| Wyoming | 4.5-6.5 km (2.7-3.9 mi) | Swenson 1981. |
| Michigan | < 6.4 km (3.8 mi) | Postupalsky 1977 |
| California | 1-10 km (0.6-6 mi) | Garber 1972 |
| Montana | 10+ km (6 mi+) | Klaver et al. 1982 |
| Idaho | < 10 km (6 mi) | Van Daele and Van Daele 1982 |
| Canada | < 12 km (7.2 mi) | Prevost 1977 |

**Barred owl**

Home Range/movements: Dobkin and Laidig (1990) used 1/2 mi (275 ha) and 3/4 mi (530 ha) radius circles to distinguish barred owl territories in southern New Jersey. Continued work in south Jersey, which included sonographic analysis of vocalizations, suggested that due to the poor quality of the habitat and heavy overlap with Great Horned owl home ranges, barred owl home ranges may be much larger than those found typically in other portions of the species geographic range (Laidig 1992; Laidig and Dobkin 1992). In addition, it has been suggested that barred owls may expand or vacate their territories during the winter months (Elody 1983; Bosakowski et al. 1987).

**TABLE NINE**: Summary of barred owl home range data. .

| Location | Home Range | Source |
|---|---|---|
| Minnesota | 228.6 ha (86.1-369 ha)<br>565 ac (213-912 ac) | Nicholls and Warner 1972 |
| Minnesota | 274-507.8 ha<br>676.7-1256.5 ac | Fuller 1979 |
| Minnesota | 274 (86-770 ha)<br>676 (213-1903 ac) | Nicholls and Fuller 1987 |
| Michigan | 118-282 ha (291-697ac) | Elody and Sloan 1985 |
| Virginia | 567.8 ha (258.9-979.6 ha)<br>1402.7ac (639.5-2420 ac) | Hegdal and Colvin 1988 |

**Indiana bat**

Home Range/Movements: Studies on Indiana bats have demonstrated that the species will move around to different habitats based upon their seasonal needs. These movements include migration to summer maternity roosts, general roosts, and summer foraging grounds. In portions of the country, research indicates that bats travel significant distances north to summer roosts, although they may also move in other directions as well (U.S. Fish and Wildlife Service, 1999). In New Jersey, Indiana bats may remain in or around the hibernacula, disperse to summer roost sites in nearby woodlands, or perhaps travel greater distances.

In general, migration to hibernacula begins in August, with bats arriving in late August to early September (Barbour and Davis 1969). Beginning in April, bats move to summer roosts, with the females leaving first. Female bats dispersed between 6.4 and 16-km (4-10 mi) from their hibernacula in Kentucky while several studies reported male bats to move between 4-16 km (2.5-10 mi)(USFWS 1999). An old church building used as a primary summer roost in Pennsylvania

was 2.4 km (1.4 mi) from the hibernacula (Hassinger and Butchkoski 2001). Conversely, in the fall when the species swarms and mates, male Indiana bats roosted within 2.4 km (1.5 mi) (Craig Stihler in USFWS 1999) and 5.6 km (3.5 mi)(Kiser and Elliot 1996) in Kentucky and West Virginia respectively. Stihler (1996) reported males moved up to 4.2 km (3.5mi) between fall roost sites and their winter cave in West Virginia.

Once reaching their summer habitats, Indiana bats may forage over a variable area. Foraging ranges differ slightly for males and females, and also depend on reproduction and age. In Illinois, Garner and Gardner (1992) reported movements of between (0.16 -1.63 mi)(see Table 1). Post-lactating adult females exhibited the largest foraging range and preferred floodplain areas with closed (>80%) canopies. Hassinger and Butchkoski (2001) documented main foraging ranges of between 38.8 (99.5 ac) to 111.9 ha. (284 ac) in Pennsylvania. A summary of other studies conducted around the country is provided in Table 2. *M. sodalis* is known to have exceptional navigational skills. When 500 bats were released 200 miles north, south and west of a cave in Kentucky, two thirds of those released to the north returned to the cave. Of those released to the south, one third returned, which is impressive considering that they were outside of their normal range, and therefore, the area was not familiar to them (Barbour and Davis 1969). The U.S. Fish and Wildlife Service (1999) recommends banding juveniles at summer roost sites, which would provide information on movements and survival rates. They also suggest using GIS, aerial photographs and National Wetland Inventory maps to identify and locate potential roost sites.

**TABLE TEN**: Foraging ranges of reproductively active adult female, adult male and juvenile *M. sodalis* in Illinois. Distance, which refers to the mean distance from the roost to the geometric center of foraging range, is given in km and miles.

| Repro. Condition Sex, and Age | Number Bats | Number Nights | Foraging Range (ha) | Distance, km (miles) |
|---|---|---|---|---|
| | | **FEMALE** | | |
| Adult-Pregnant | 2 | 8 | 51.85 | 1.05 (0.66) |
| Adult-Lactating | 5 | 16 | 94.25 | 1.04 (0.65) |
| Adult-Post Lact. | 1 | 6 | 212.67 | 2.60 (1.63) |
| Juvenile-Nonrep. | 2 | 3 | 37.00 | 0.25 (0.16) |
| MALE | | | | |
| Adult-Nonrep. | 2 | 6 | 57.33 | 0.56 (0.35) |
| Juvenile-Nonrep. | 2 | 4 | 28.25 | 0.54 (0.34) |
| **TOTAL** | **14** | **43** | | |

**TABLE ELEVEN**: Foraging distances for Indiana bats.

| **Location** | **Sex and/or Age** | # of **bats** | Distance (km/ **mi)** | **Study** |
|---|---|---|---|---|
| Kentucky | Males/females | 14/1 | max. 2.4 km (1.46 mi) +/- .15 km (.25 mi) | Kiser and Elliot 1996 |
| Missouri | Adults | 6 | max. 2 km (1.2 mi) | LaVal et al. 1977 |
| Florida | Adults/young | 25-28 | 0.82 km (.49 mi) | Humphrey et al. 1995 |
| Pennsylvania | Males/females 1/7 | | max 3.6 km (2.2 mi) | (Hassinger and Butchkoski 2001) |